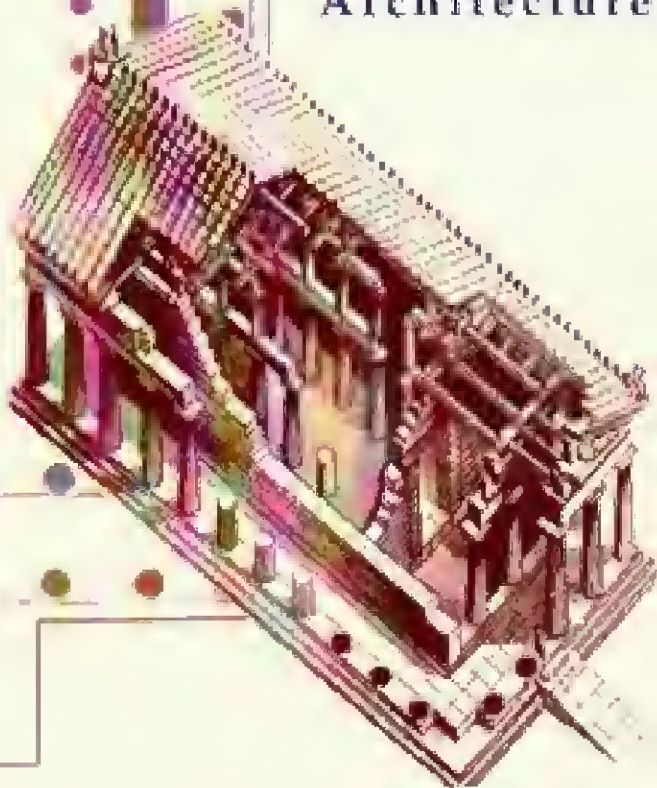


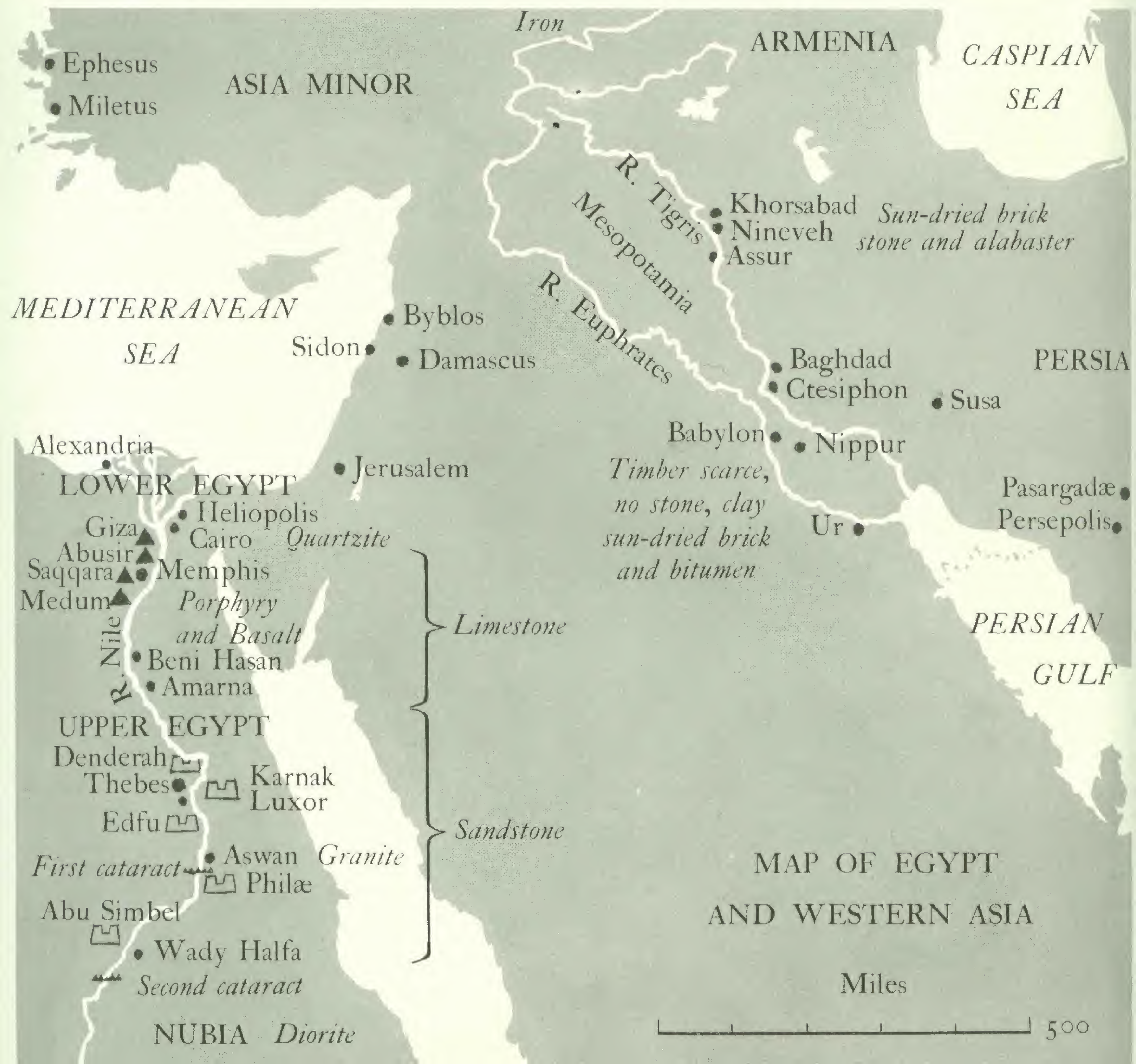
Graphic History of Architecture



JOHN
MANBRIDGE

EGYPT

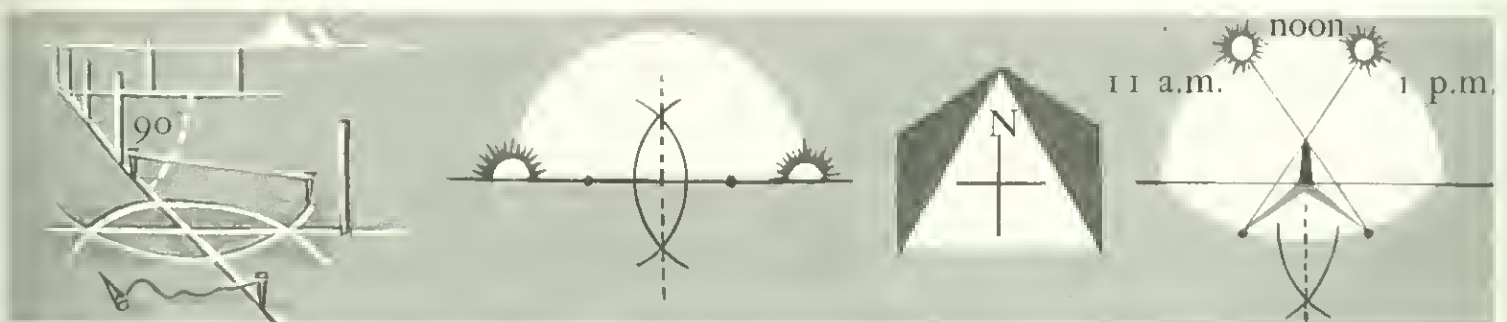
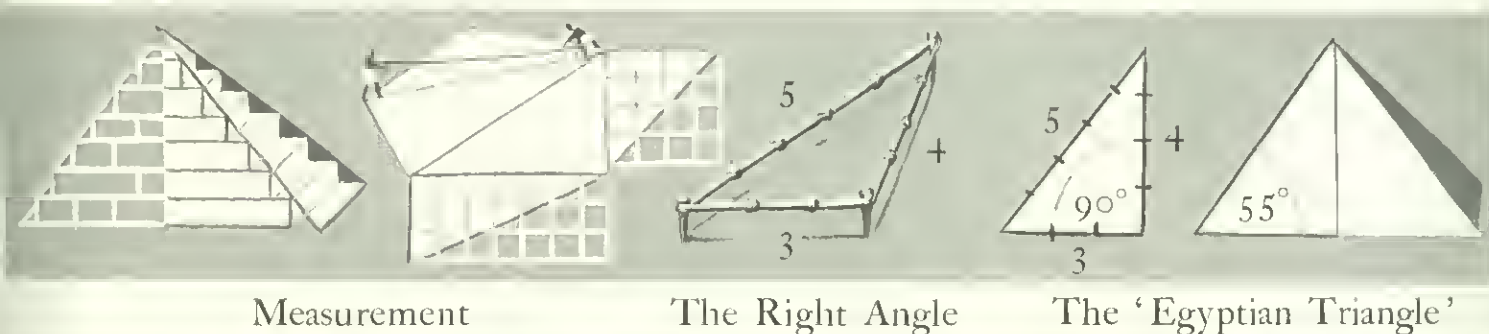
THE ARCHAIC PERIOD		THE OLD KINGDOM				First Intermediate Period	THE MIDDLE KINGDOM		Second Intermediate Period
Dynasty I	II	III	IV	V	VI		IX	XII	
c.3200 B.C.	2980	2789	2680	2565	2420	2258	2134	1991	1786
Union of Upper and Lower Egypt Capital: Heliopolis		Capital: Memphis The Age of the Pyramids					The Feudal Age Capital: Thebes		Invasion of the Hyksos from Asia



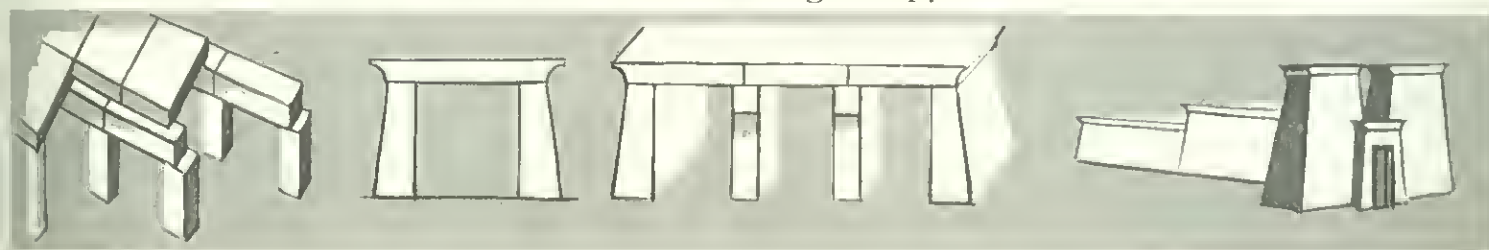
INTRODUCTION

THE NEW KINGDOM				THE LATE PERIOD			THE PTOLEMAIC PERIOD	
XVIII	XIX	XX		XXI	-	XXXI		
1570	1314	1197	1085		671-663	525	332	30 B.C.
The Egyptian Empire in Asia and Nubia Capital: Thebes					Assyrian invasion	Domination of Persia		Egypt a Roman province

Egypt was a narrow strip of highly productive soil, 8 to 12 miles wide, along the banks of the Nile, about one-fifth of the area of England and Wales. From pre-dynastic times sun-dried mud bricks were used for houses, but these have not survived: timber was scarce and hence arches were built without centering. There was however an abundance of limestone, sandstone and granite. The planning of irrigation canals and fields, necessitated by the annual inundations of the Nile, demanded a system of geometry (Gk land measuring). Believing in a life after death, the Egyptians thought that the body should be preserved in a lasting tomb; this became a geometric construction of great solidity and permanence.



Method of orientating the pyramids



Temples constructed with columns, beams and massive, battered external walls

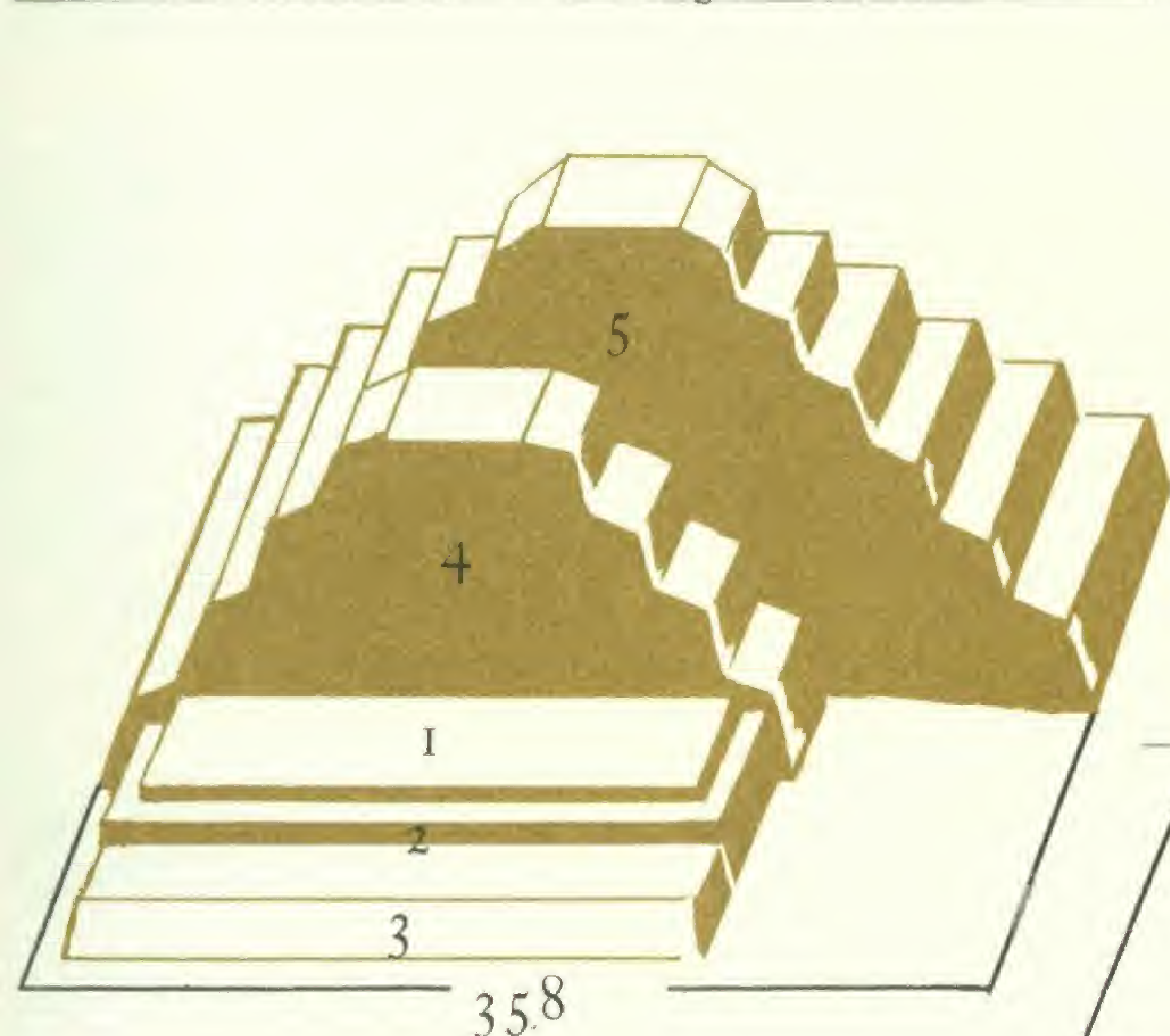
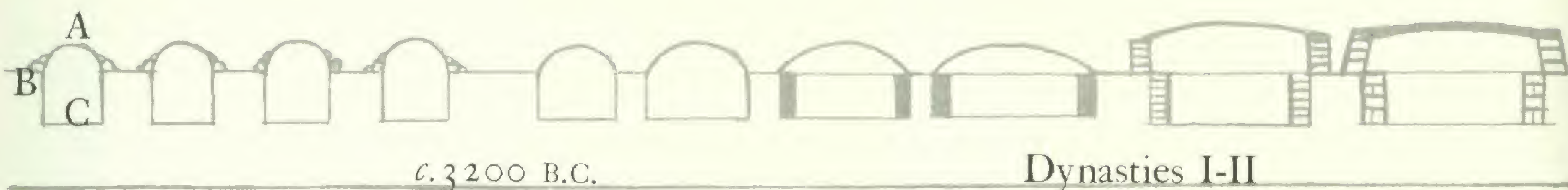
EGYPT

Pit graves in desert cemeteries:
sand heap A surrounded by
circle of stones B over grave C

Pit graves transformed into
tombs by brick lining and flat
wooden or arched brick roofs

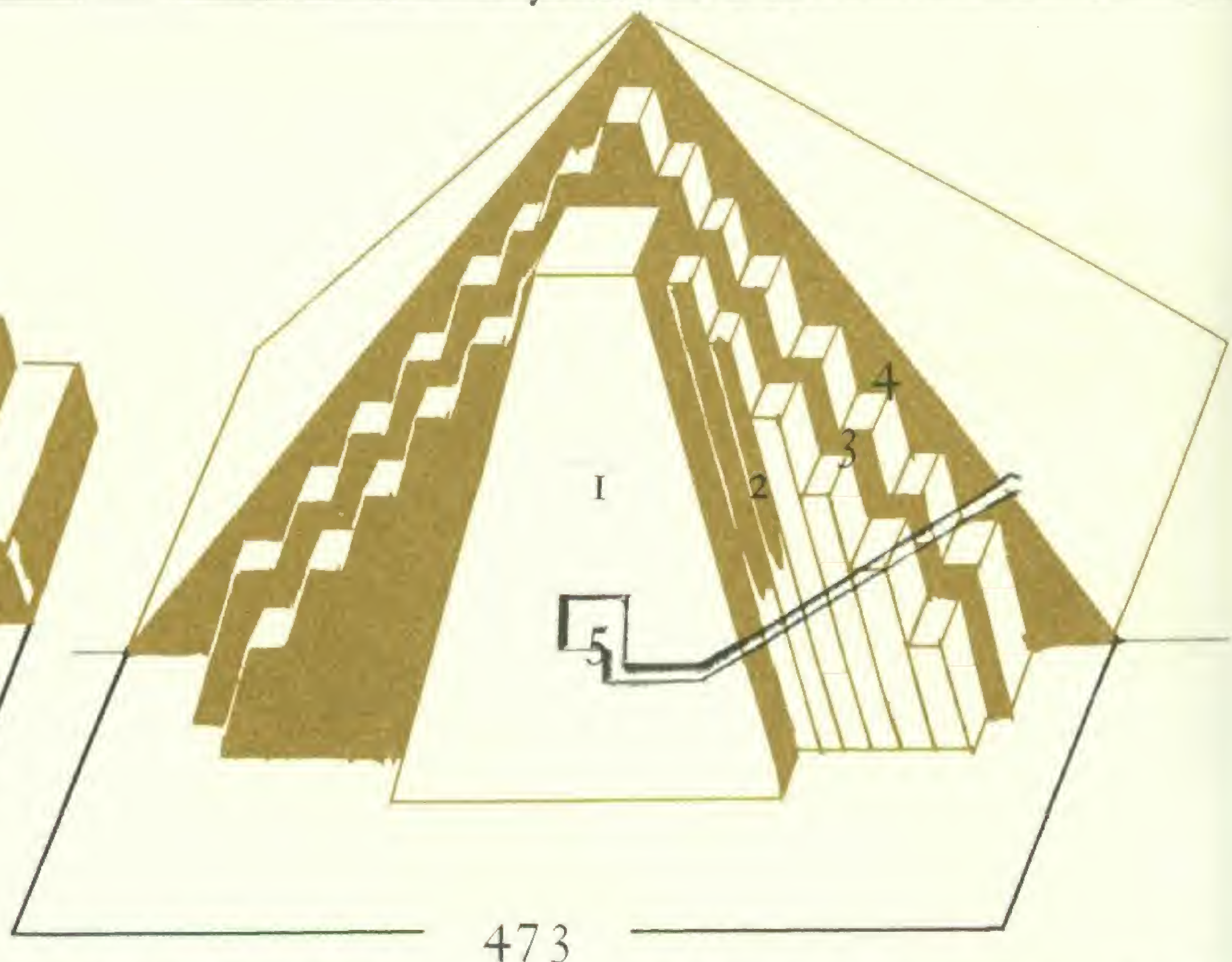
Walls of
sun-dried
brick

Beginning
of *stone*
masonry



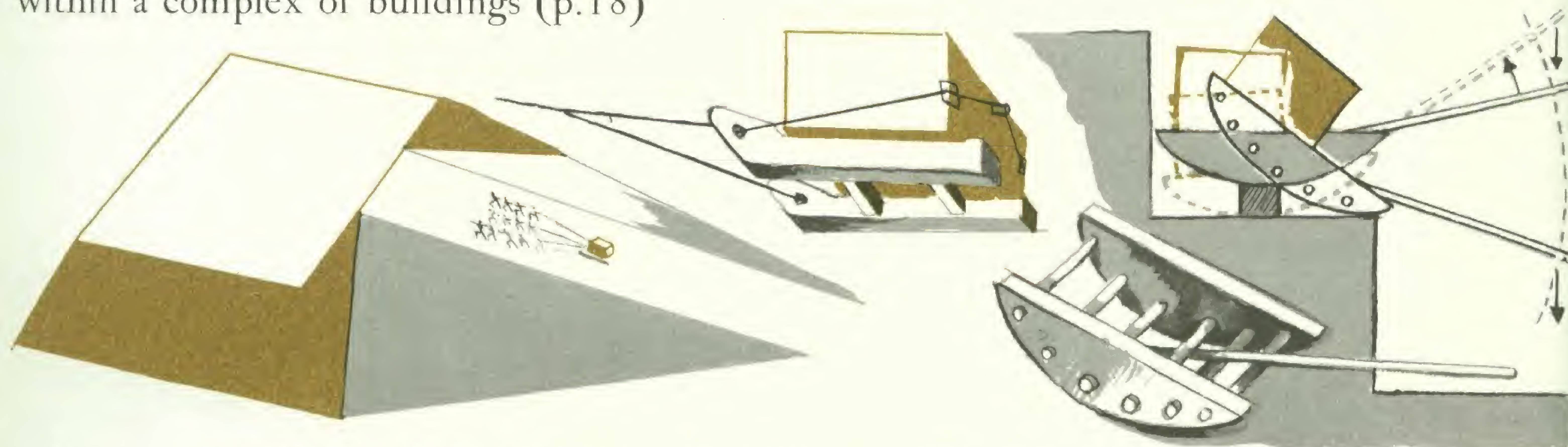
THE STEP PYRAMID, Saqqara,
Dynasty III: Section looking west
Built by Imhotep, architect to
King Zoser.

1 Begun as a mastaba-tomb. 2-5 Then
successively enlarged, in limestone. Set
within a complex of buildings (p. 18)



THE PYRAMID OF MEDUM, Dynasties III-IV
Section looking west, reconstructed

1 Centre core. 2 Successive layers added, at about
75°, each of local stone and cased with limestone.
3 Enlargement of the pyramid. 4 Steps filled in
with a facing of limestone. 5 The tomb chamber

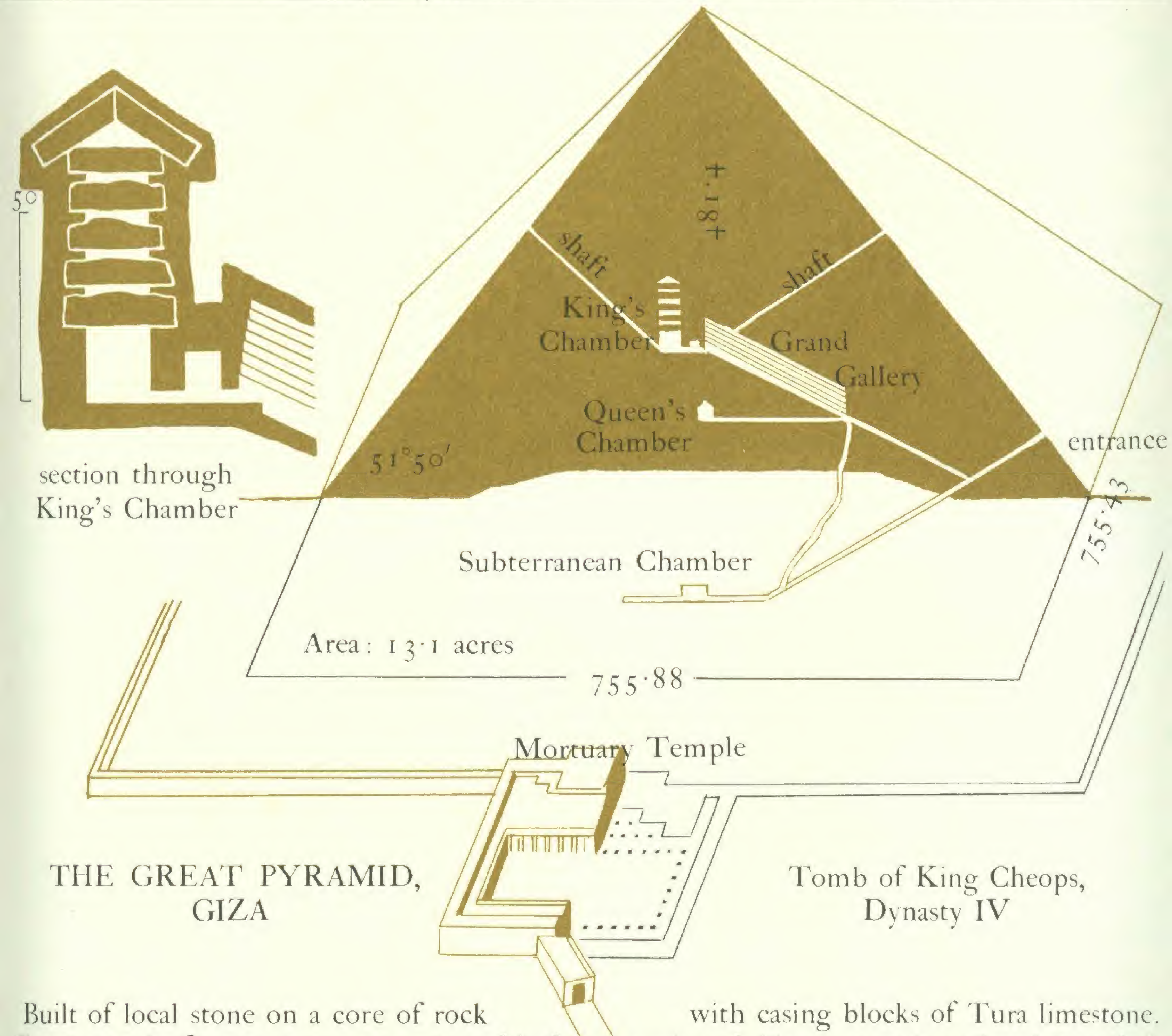
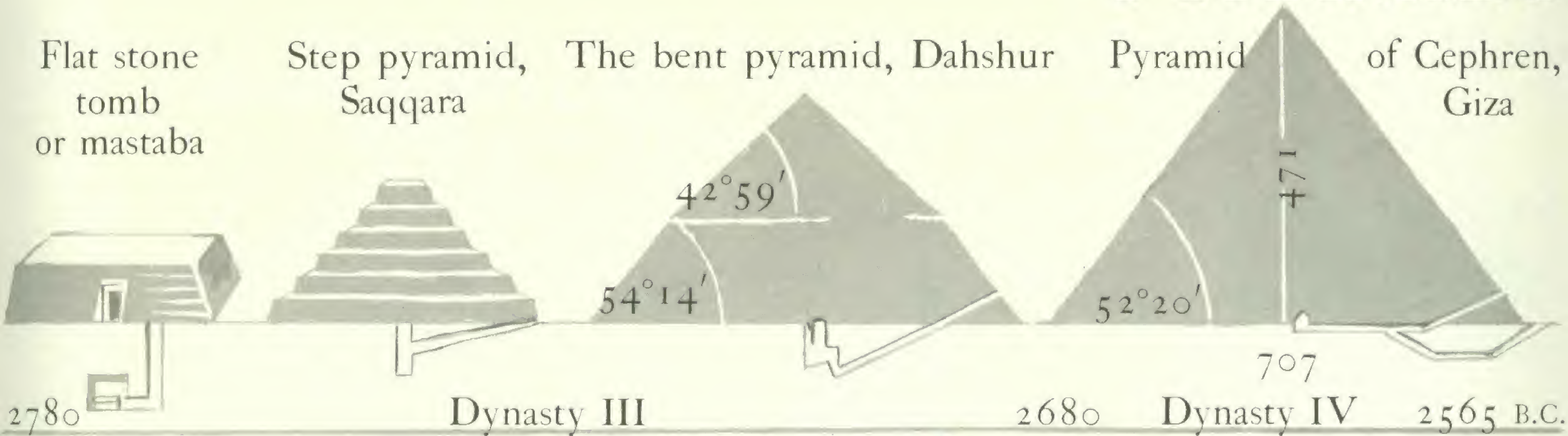


Stones on sledges, pulled up long earth ramps

The Rocker; pulleys were unknown

Suggested methods of hauling and lifting stones

PYRAMIDS



Built of local stone on a core of rock with casing blocks of Tura limestone. Constructed of some 2,300,000 stone blocks, each weighing approximately $2\frac{1}{2}$ tons. It is probable that for a period of twenty years 100,000 men were levied annually, during the three months' inundation of the Nile (July to October), for transporting stone. Also about 4,000 permanent skilled masons and attendant labourers were employed

EGYPT

THE OLD KINGDOM
Dynasties III-VI, 2780-2258 B.C.
The Age of the Pyramids

THE MIDDLE KINGDOM
Dynasties XI-XII, 2134-1786

The Step Pyramid, Saqqara, set within a complex of buildings of local stone faced with limestone

Built by Imhotep for King Zoser, (reconstructed) Dynasty III

The great Pyramid of Cheops, Giza, Dynasty IV

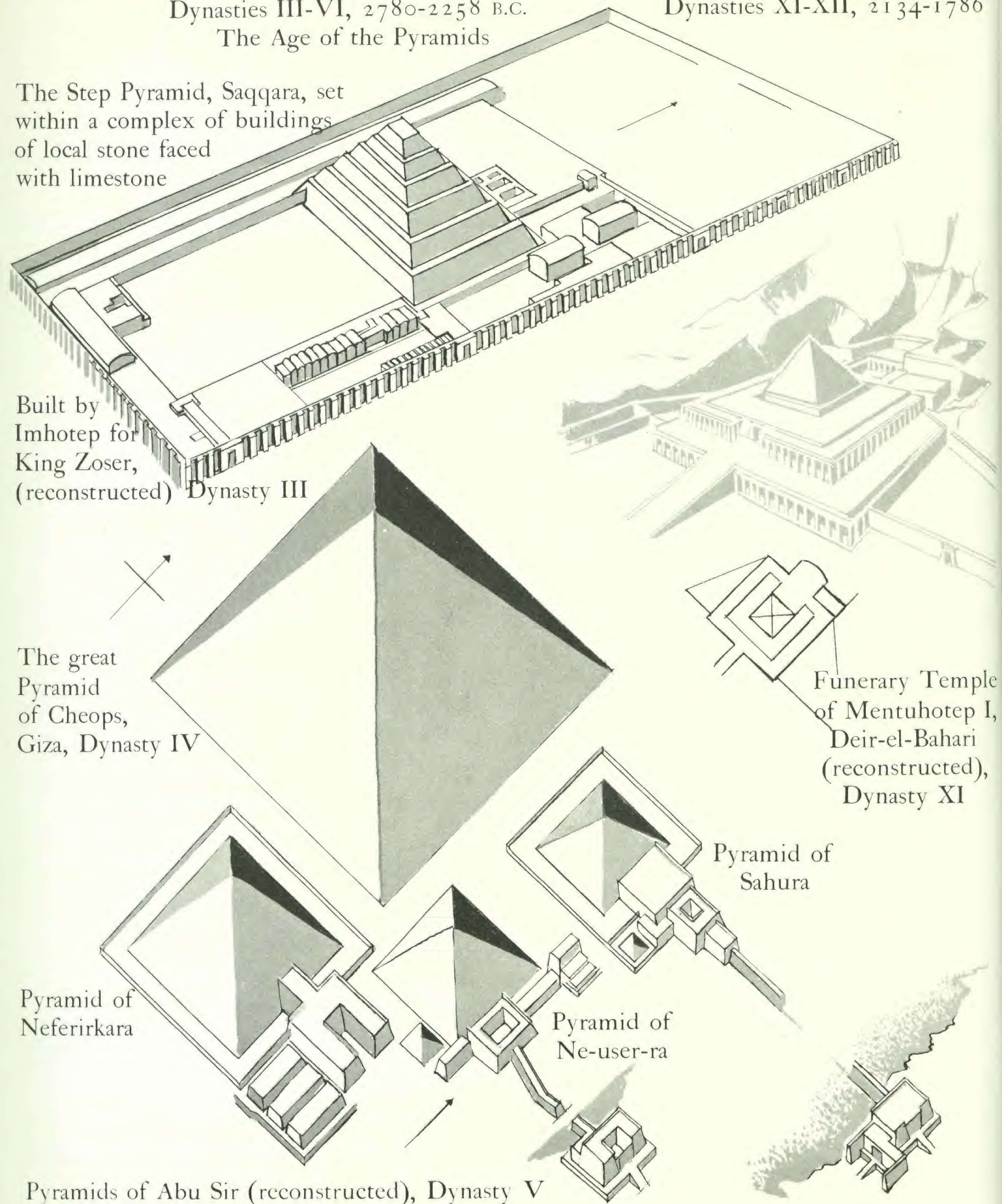
Pyramid of Neferirkara

Pyramids of Abu Sir (reconstructed), Dynasty V

Pyramid of Ne-user-ra

Pyramid of Sahura

Funerary Temple of Mentuhotep I, Deir-el-Bahari (reconstructed), Dynasty XI



COMPARATIVE BUILDINGS & PLANS

THE NEW KINGDOM

Dynasties XVIII-XX, 1570-1085 B.C.

The Age of the great Temples

THE PTOLEMAIC PERIOD

332-30 B.C.

Revival of Temples

Mortuary Temple of Amon,
Deir-el-Bahari (reconstructed),
Dynasty XVIII

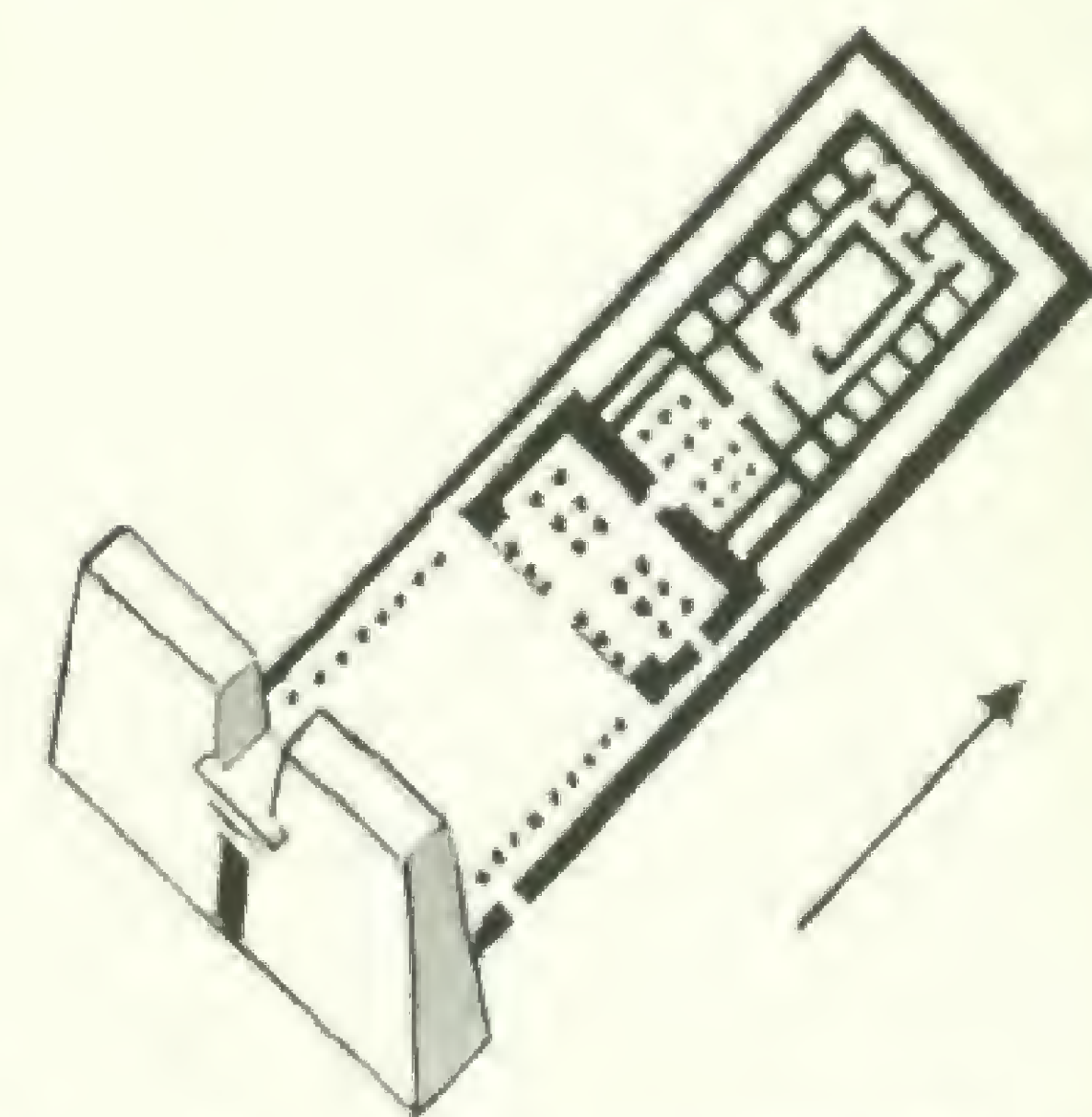
Designed by Senmut and
built for Queen Hatshepsut

The Great Temple
of Amon, Karnak,
Dynasties XVIII-XXXI
(Foundations Dynasty XI)

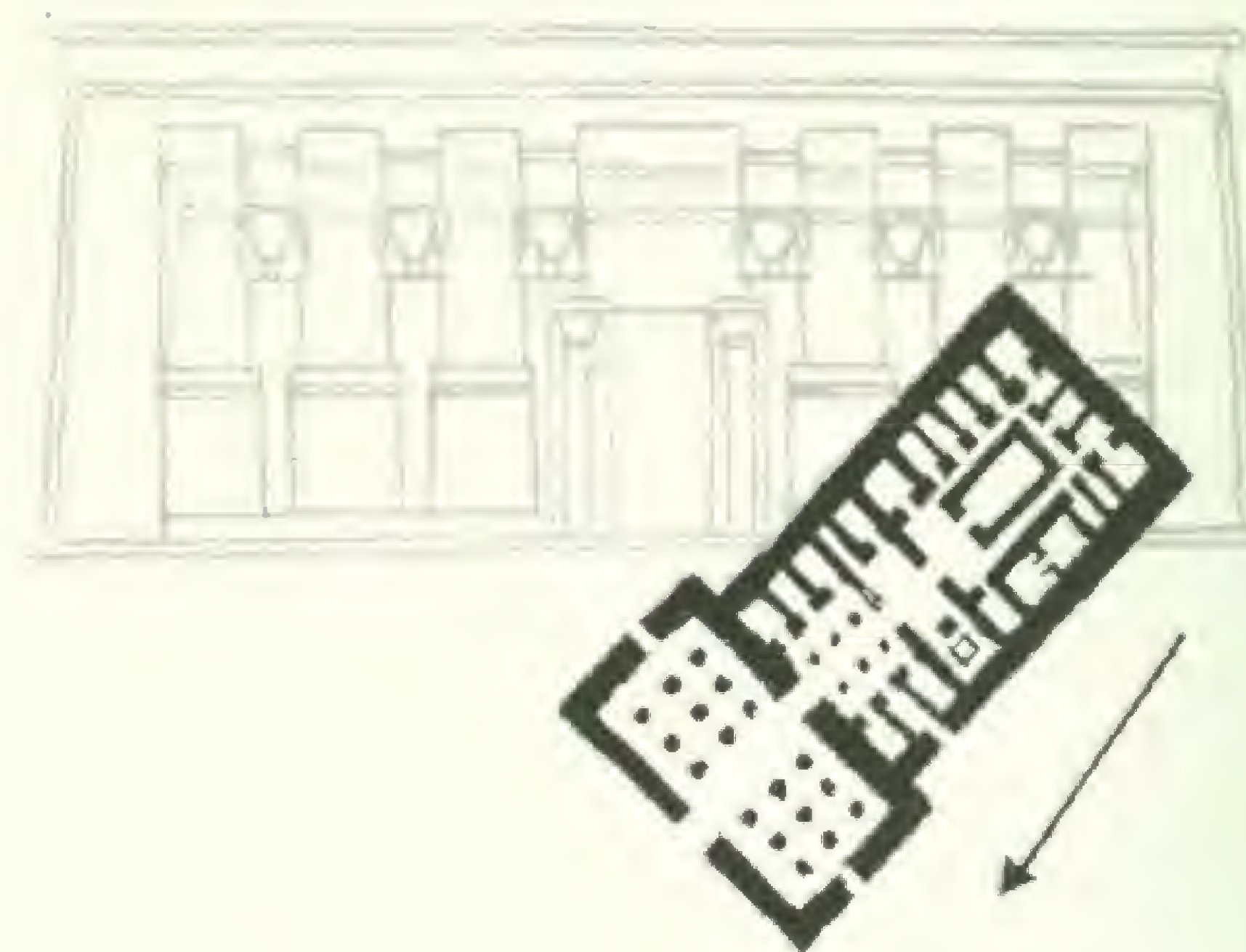
The Temple
of Amon, Luxor,
Dynasties XVIII-XIX
Begun by Amenhotep III
and added to by Rameses II

Temple of Seti I, Abydos,
Dynasty XIX

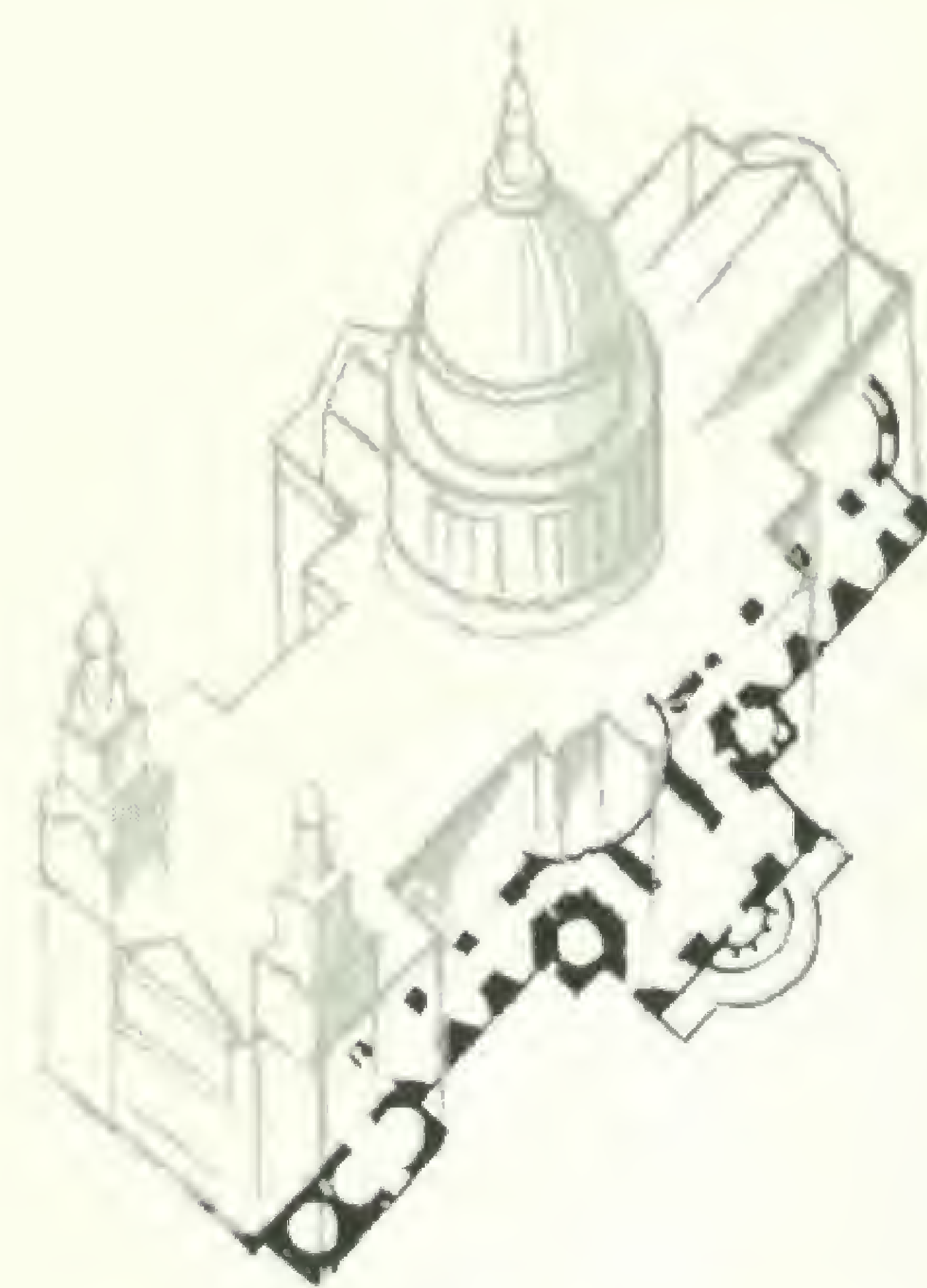
Great Temple, Abu Simbel, Nubia,
Dynasty XIX. Built for Rameses II



The Temple of Horus,
Edfu, 237-212 B.C.
Begun by Ptolemy III



The Temple of Hathor,
Dendera, 1st cent. B.C.



St Paul's, London

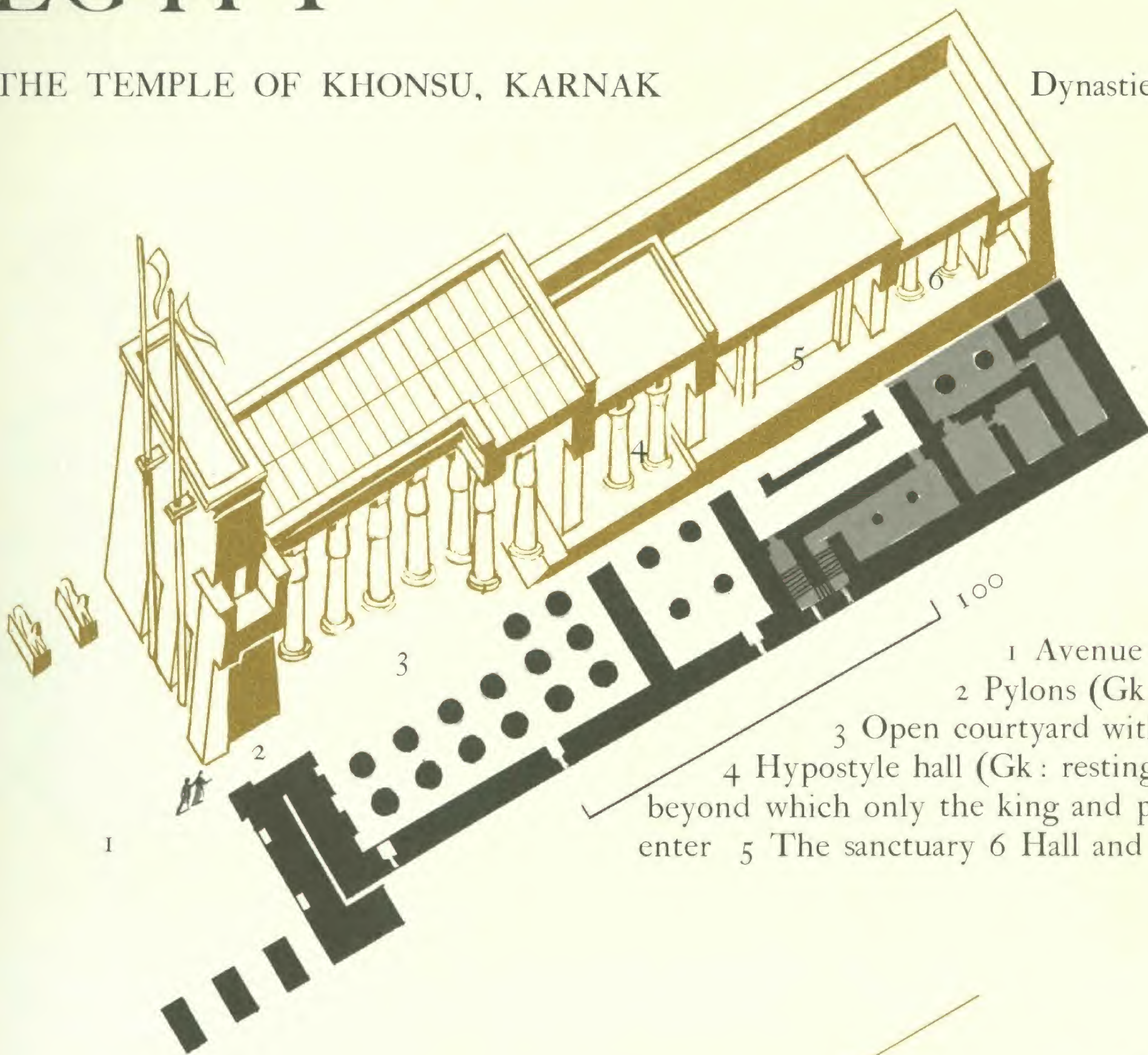
Plans and buildings in black
drawn to the same scale

500

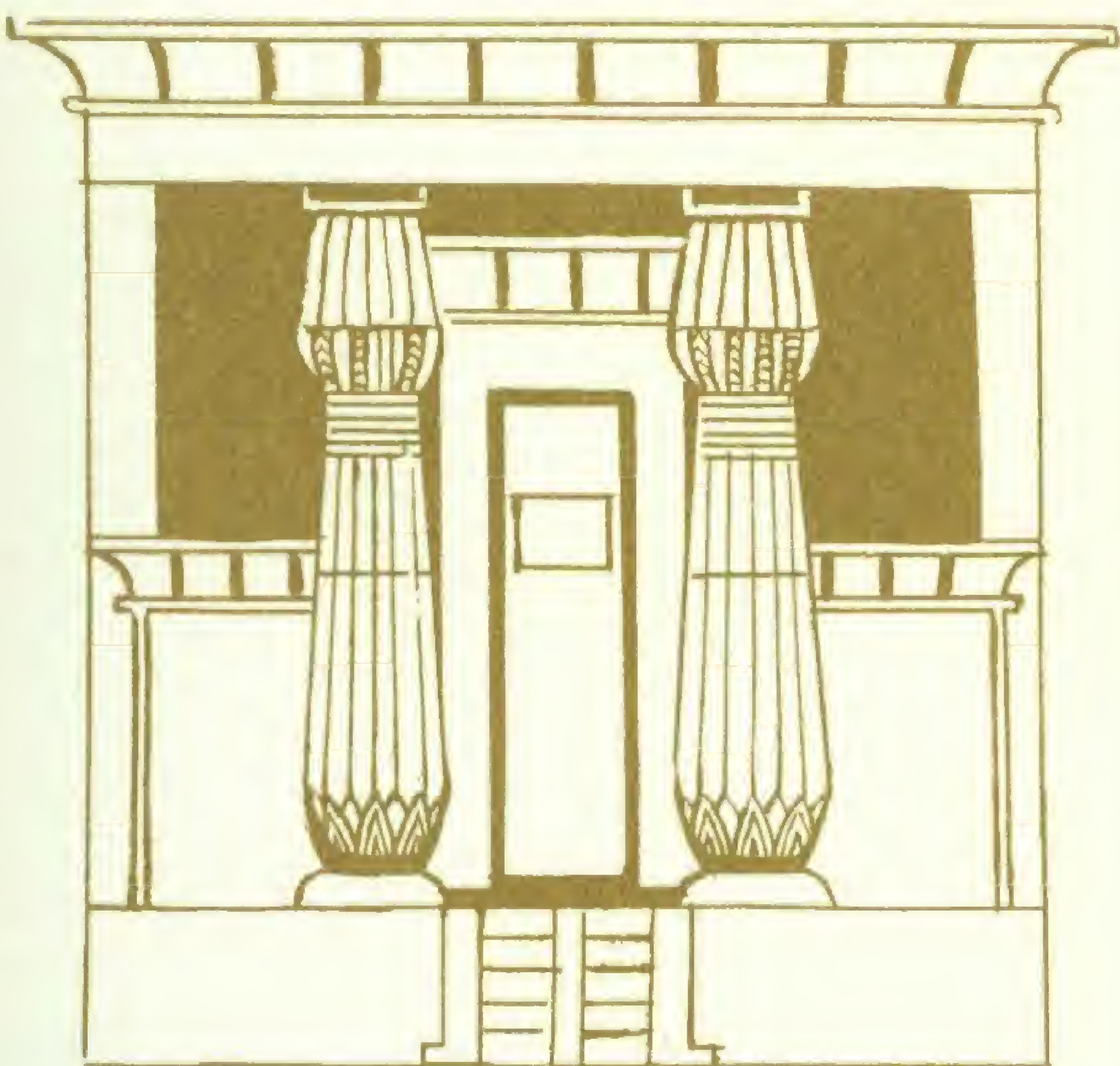
EGYPT

THE TEMPLE OF KHONSU, KARNAK

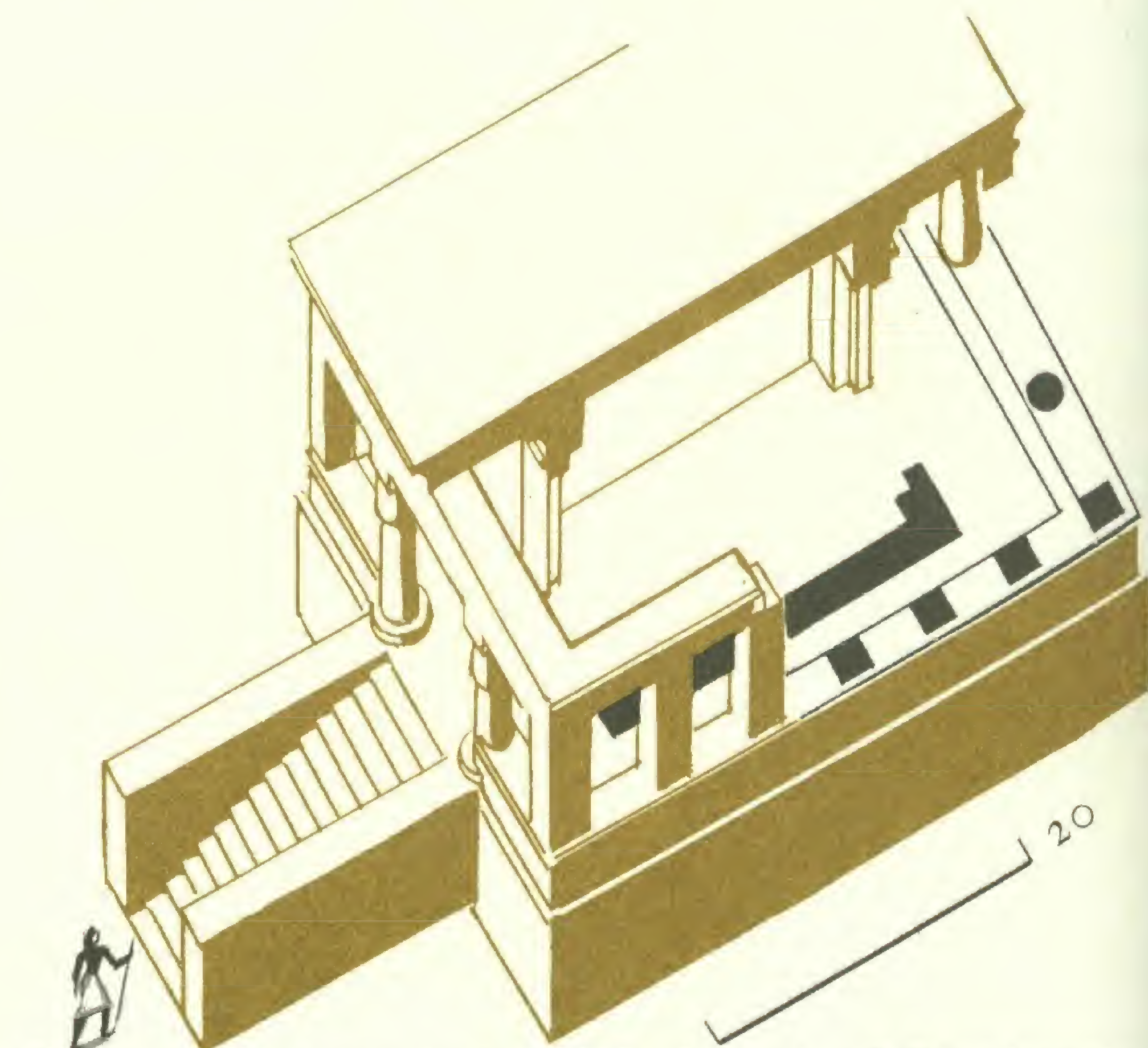
Dynasties XX-XXI



- 1 Avenue of sphinxes
- 2 Pylons (Gk : a gateway)
- 3 Open courtyard with colonnade
- 4 Hypostyle hall (Gk : resting on pillars), beyond which only the king and priests might enter
- 5 The sanctuary
- 6 Hall and store rooms

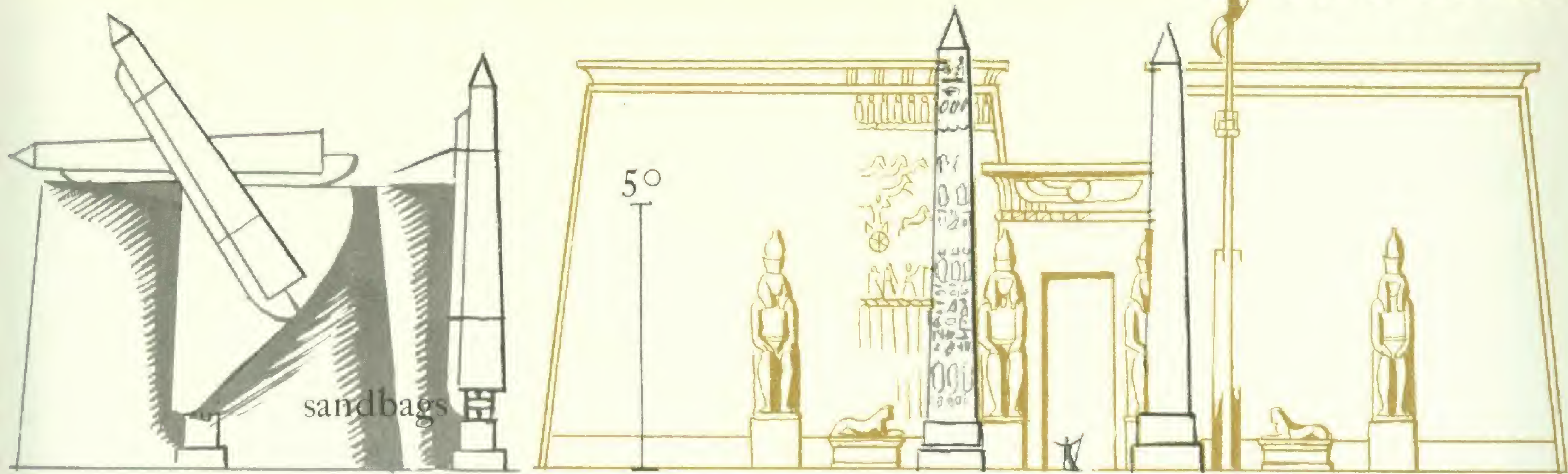


A garden shrine from a painting in a tomb, Thebes, Dynasty XIX



Temple of Amenhotep III, Island of Elephantine, Dynasty XVIII (Destroyed A.D. 1822)

TEMPLES



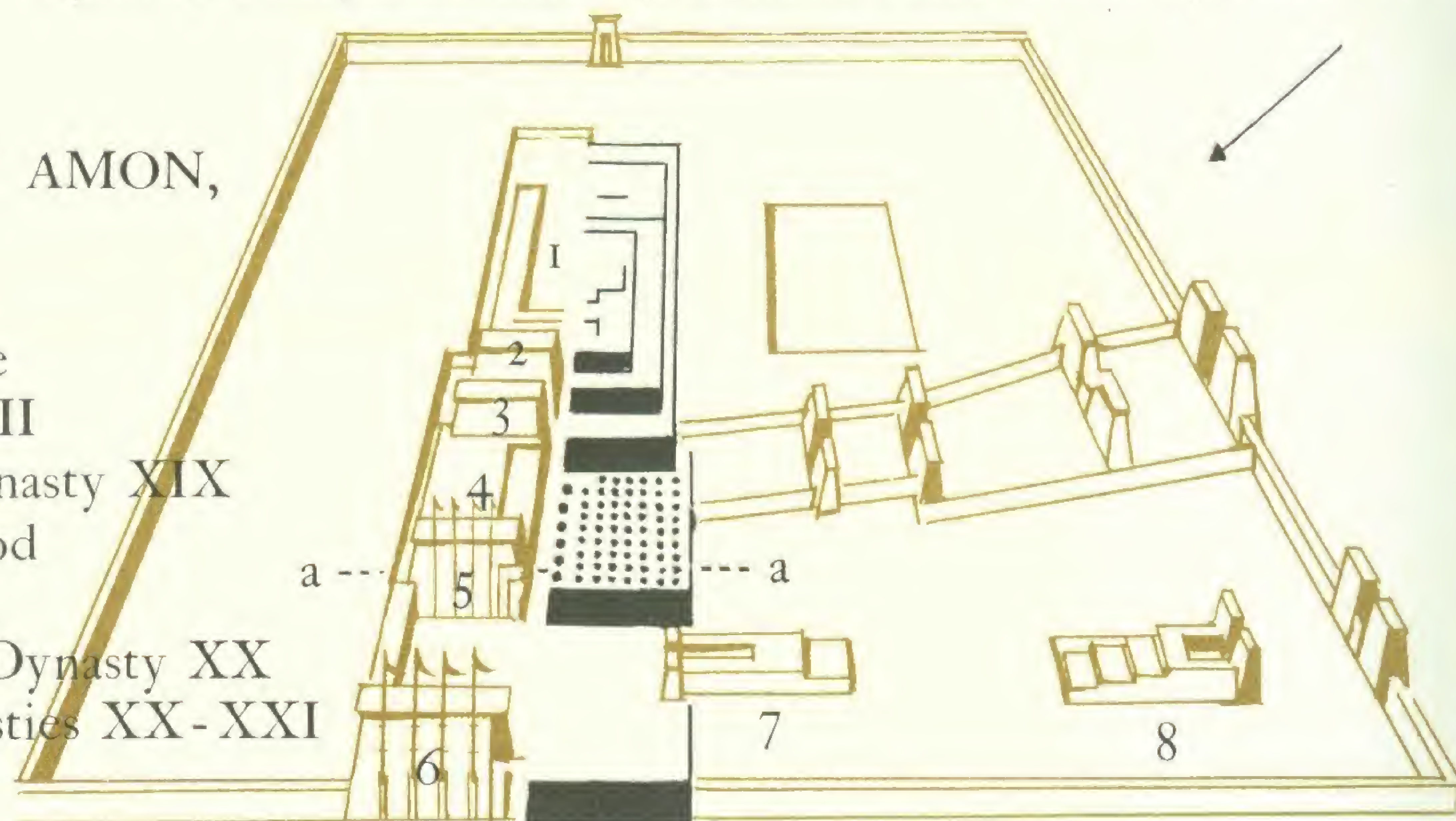
Pylons, Temple of Luxor, Dynasty XIX. Built by Rameses II

GREAT TEMPLE OF AMON, KARNAK

Built of sandstone
Begun Dynasty XII

1-4 Dynasty XVIII 5 Dynasty XIX

6 Ptolemaic period



7 Temple of Rameses III, Dynasty XX
8 Temple of Khonsu, Dynasties XX-XXI

Section

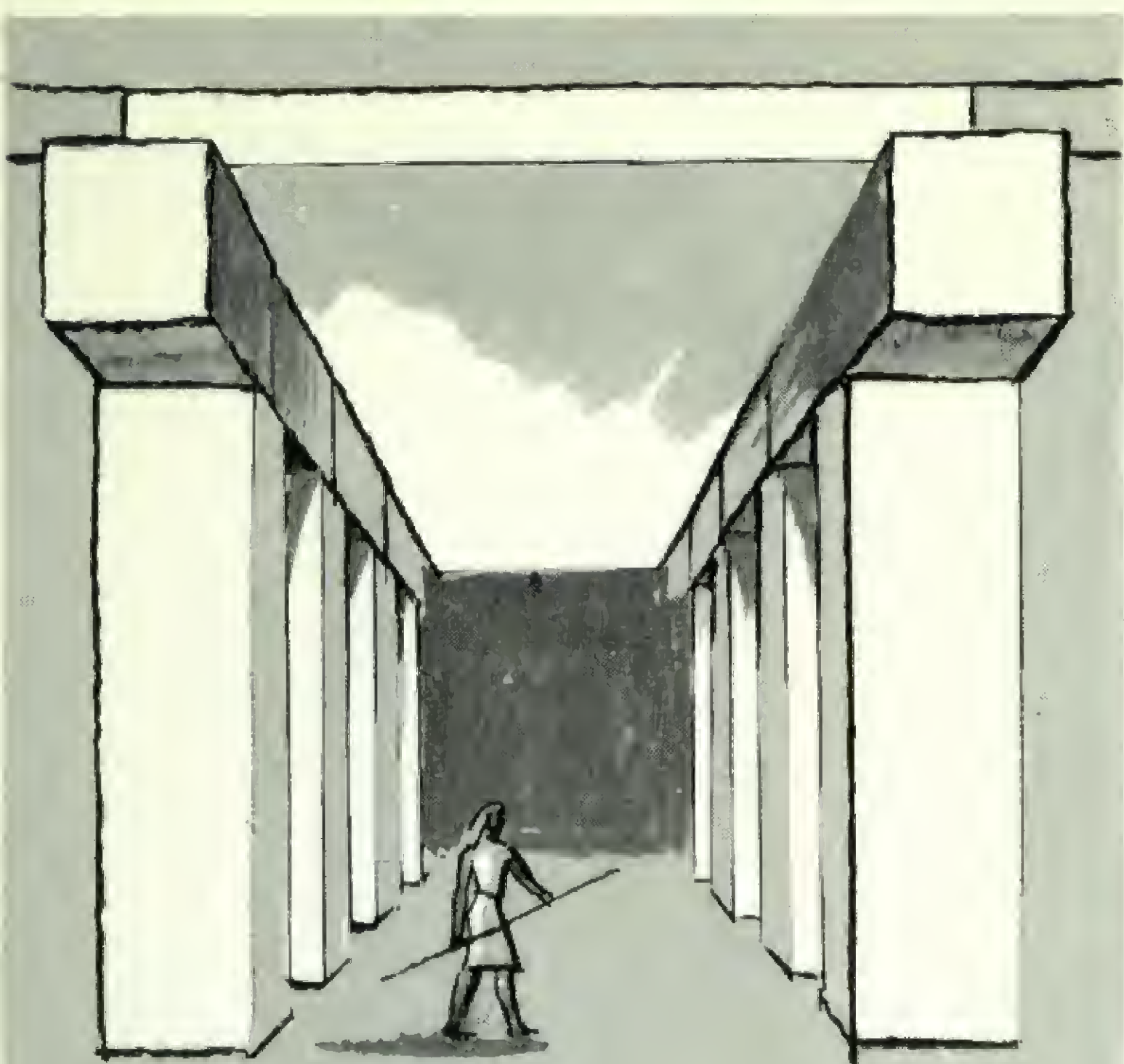
Hypostyle hall, a-a

clerestory windows

hall filled with sand and roof-slabs lowered into position

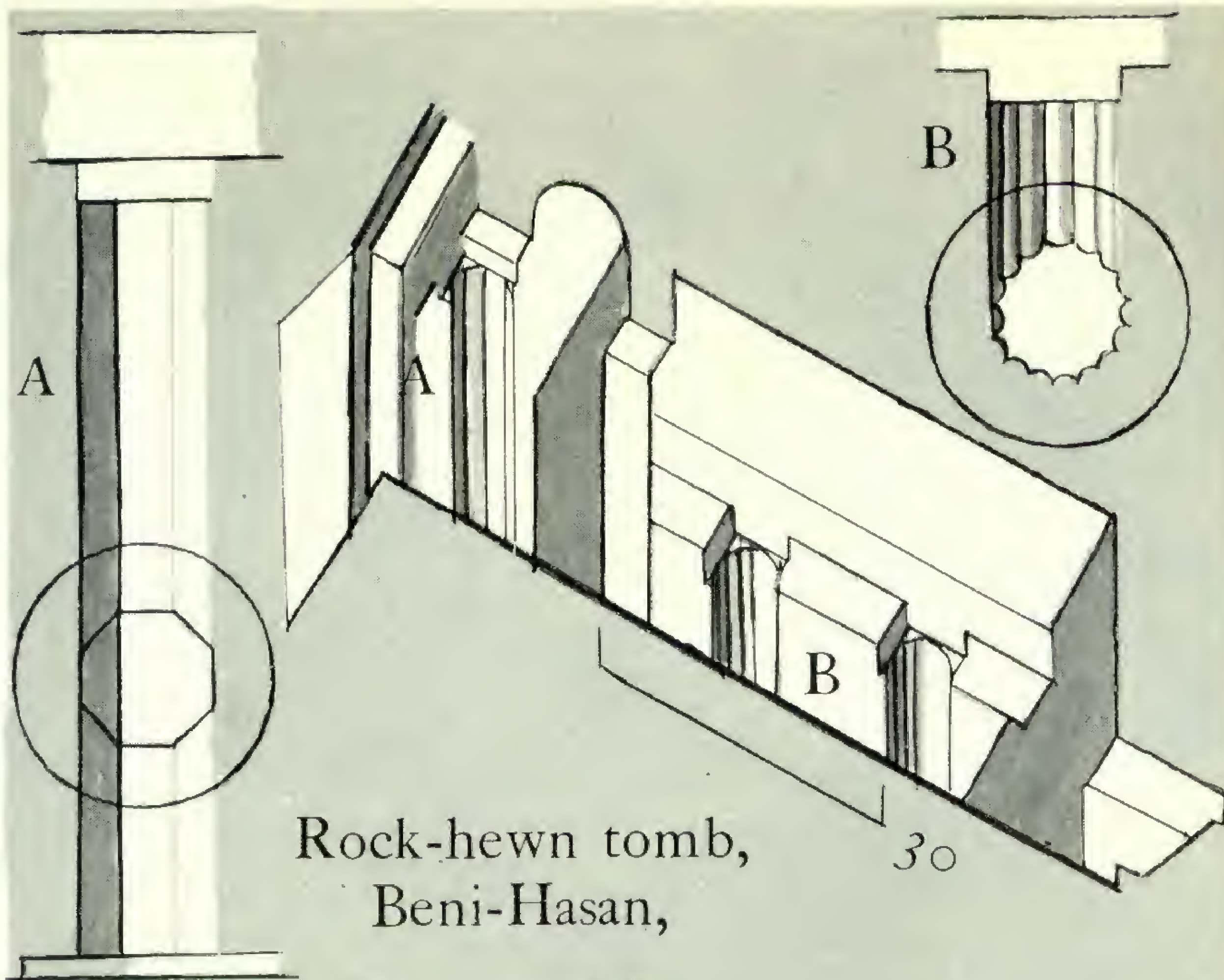


EGYPT



Valley Temple
built of granite:
Pyramid of Cephren, Giza.

Dynasty IV



Rock-hewn tomb,
Beni-Hasan,

Dynasty VII

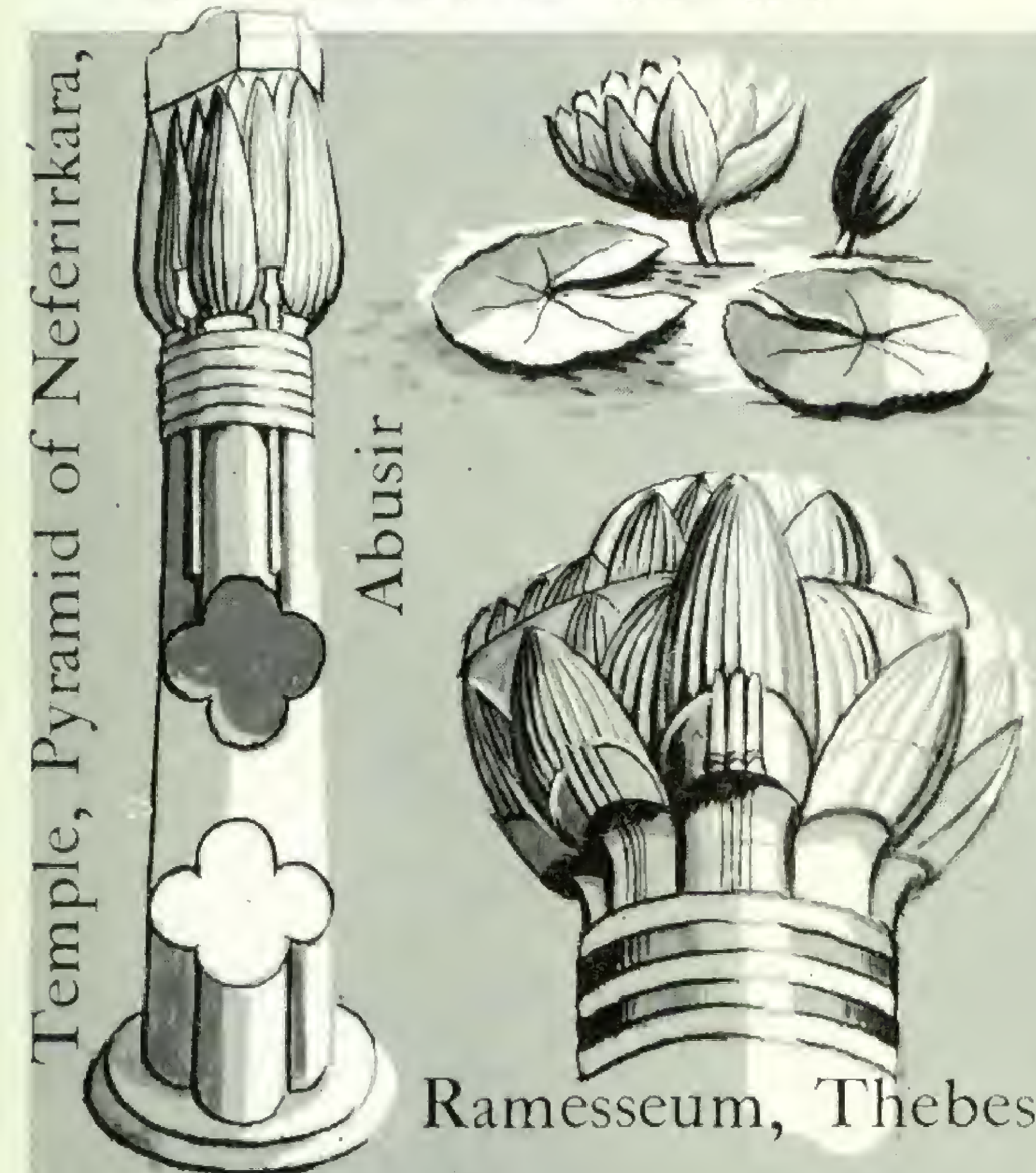


Portico, Temple-tomb,
Deir-el-Bahari

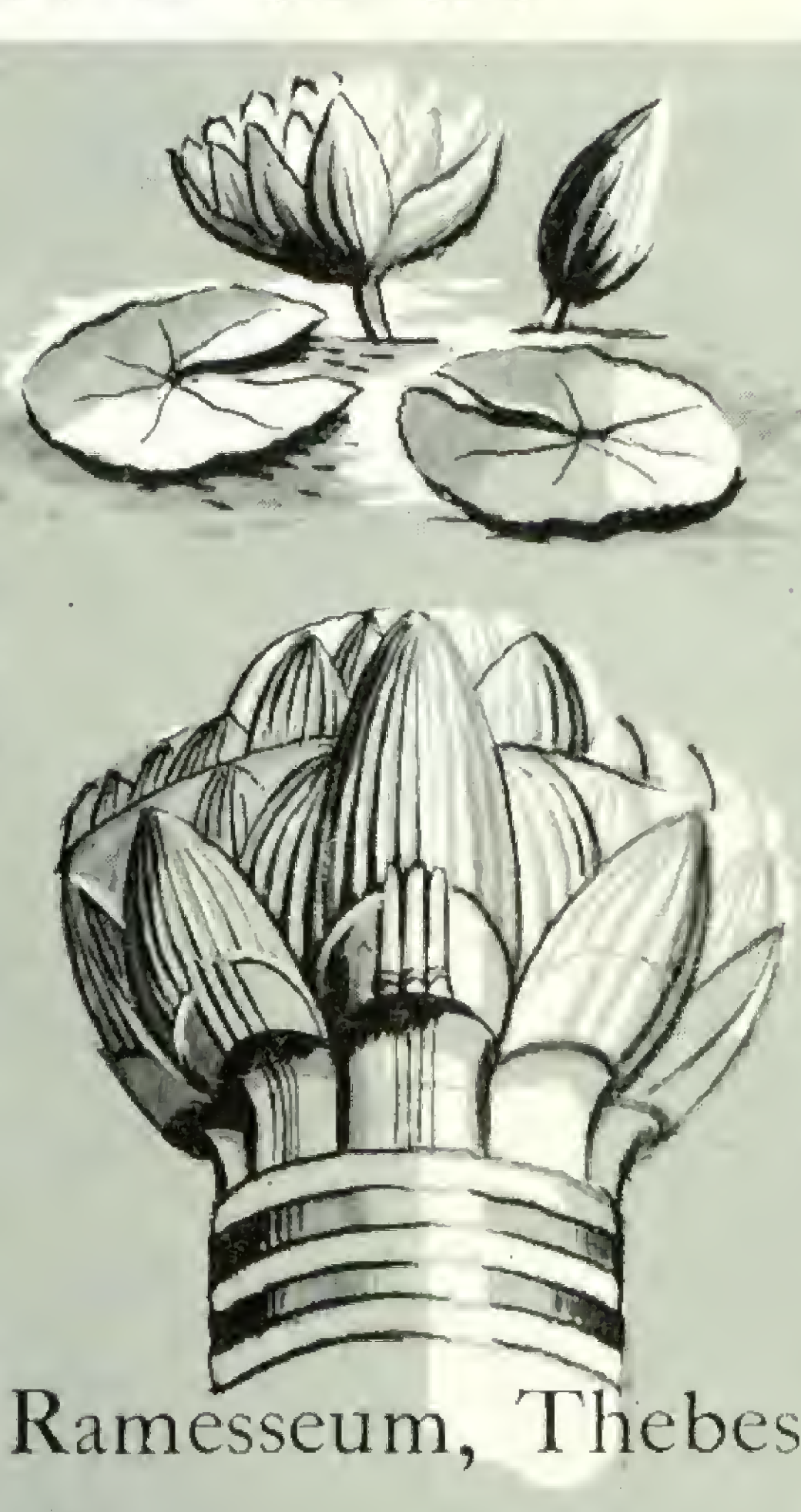
Dynasty XIX

COLUMN & BEAM

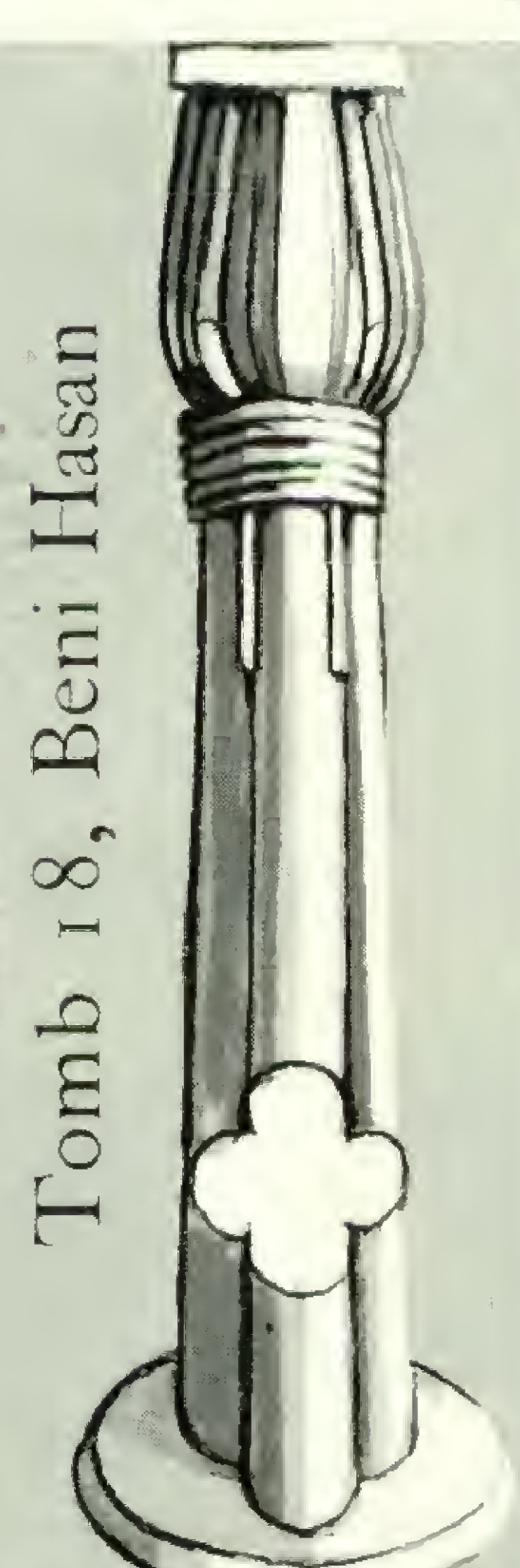
PROTO-DORIC COLUMNS



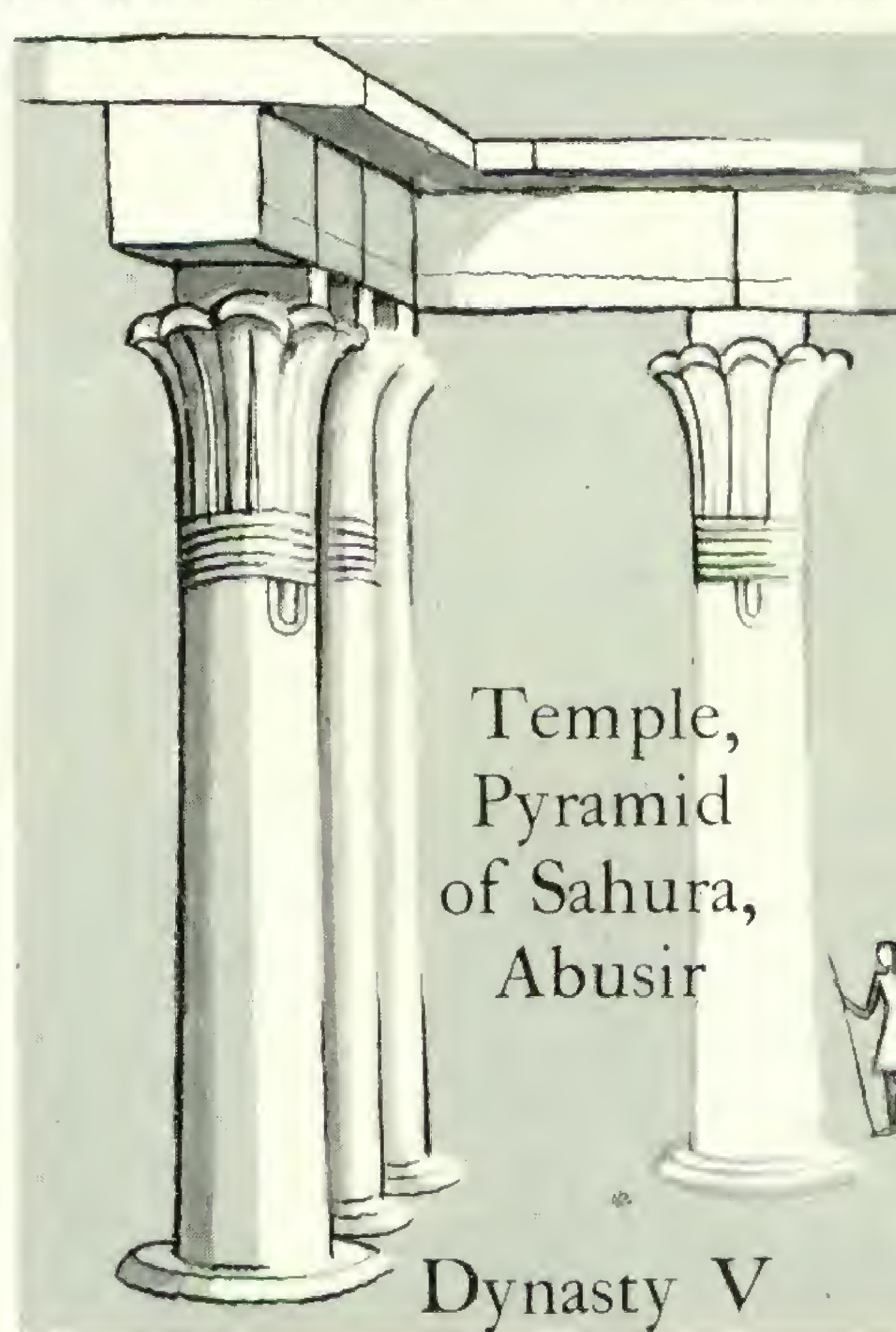
Dynasty V



Dynasty XIX



Dynasty XI



Temple,
Pyramid
of Sahura,
Abusir

Dynasty V

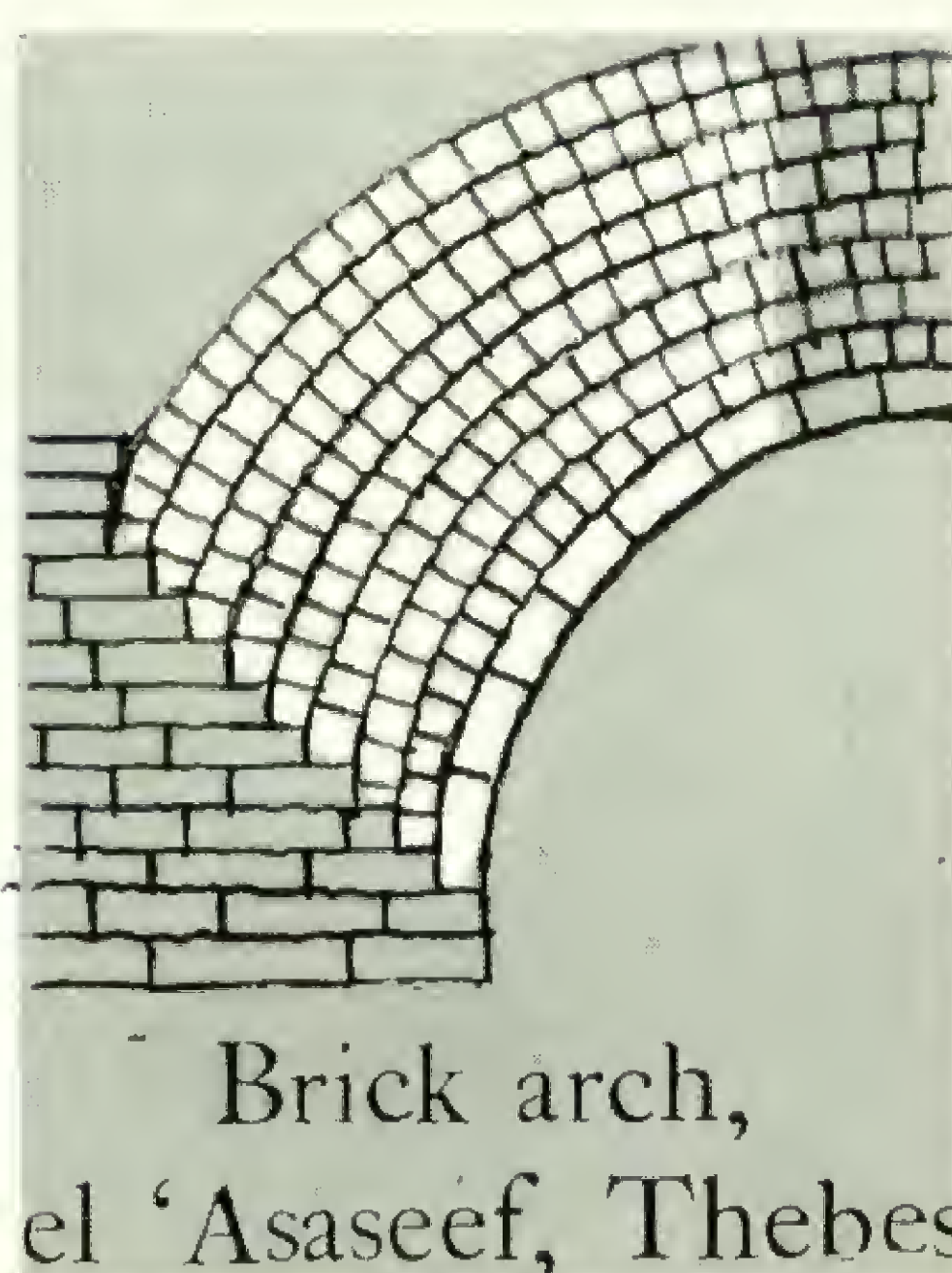
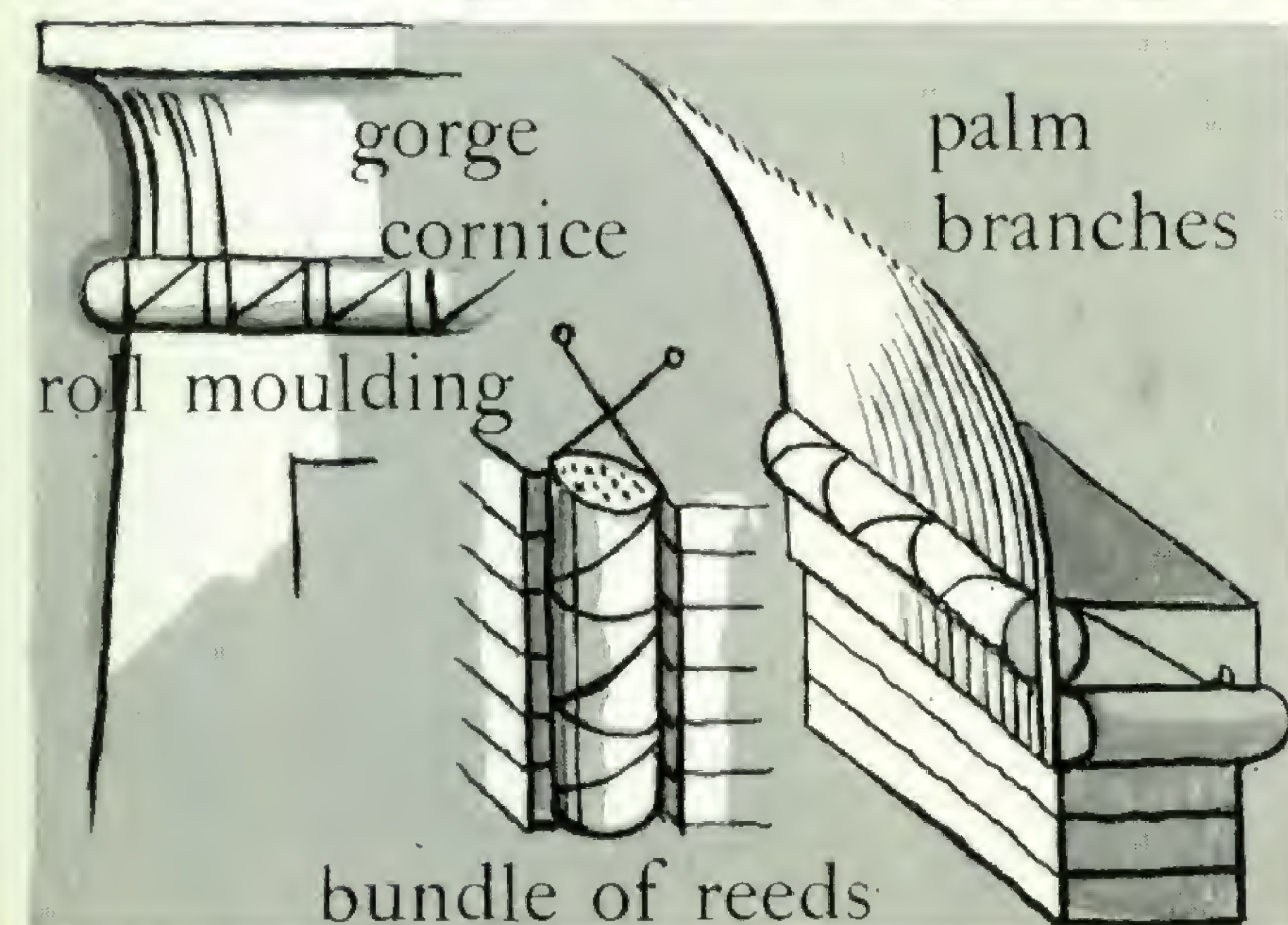


Temple of Isis,
Philae

Ptolemaic

LOTUS COLUMNS

PALM COLUMNS



Brick arch,
el 'Asaseef, Thebes



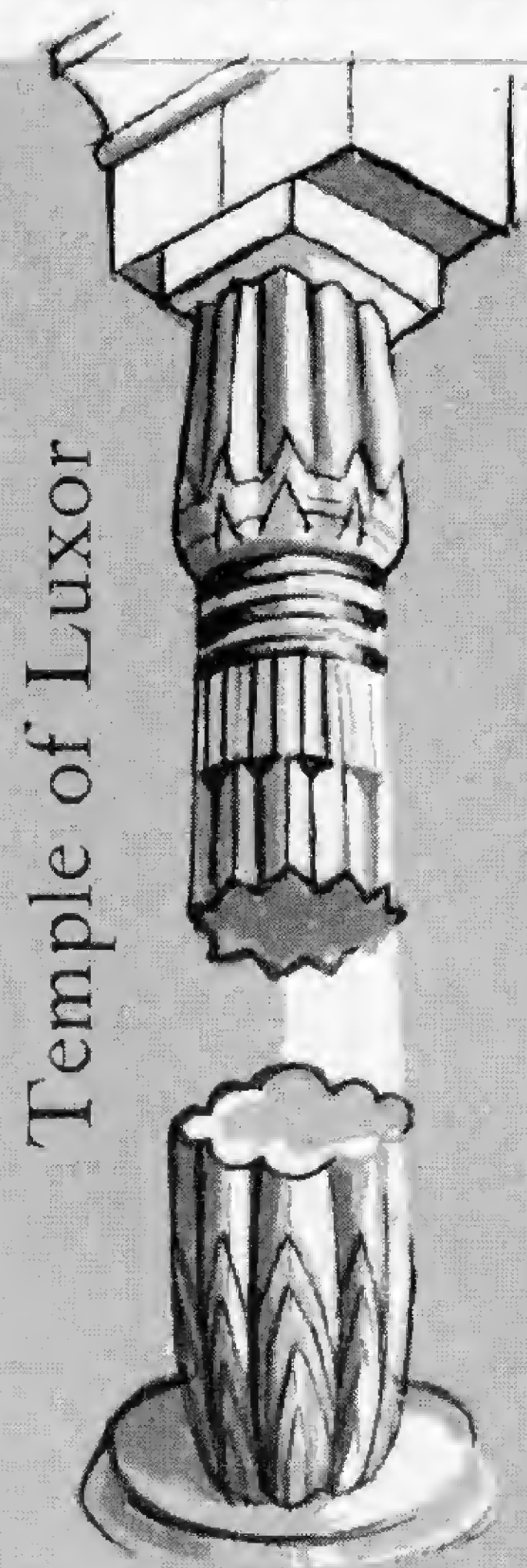
Vault of damp mud bricks laid in
slanted courses without centering

COLUMN BEAM & ARCH

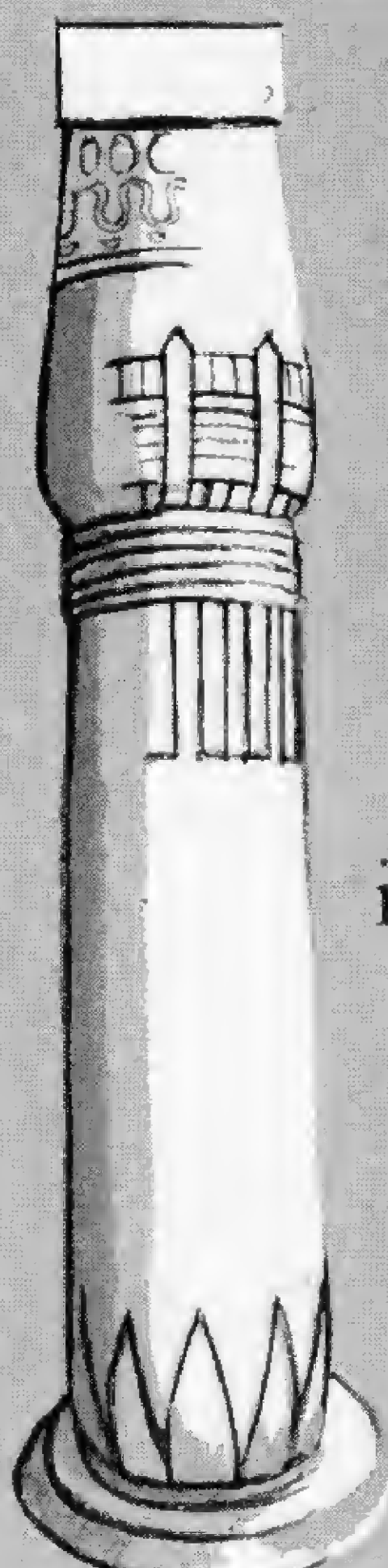
Mortuary Chapel of Ne-user-ra, Abusir



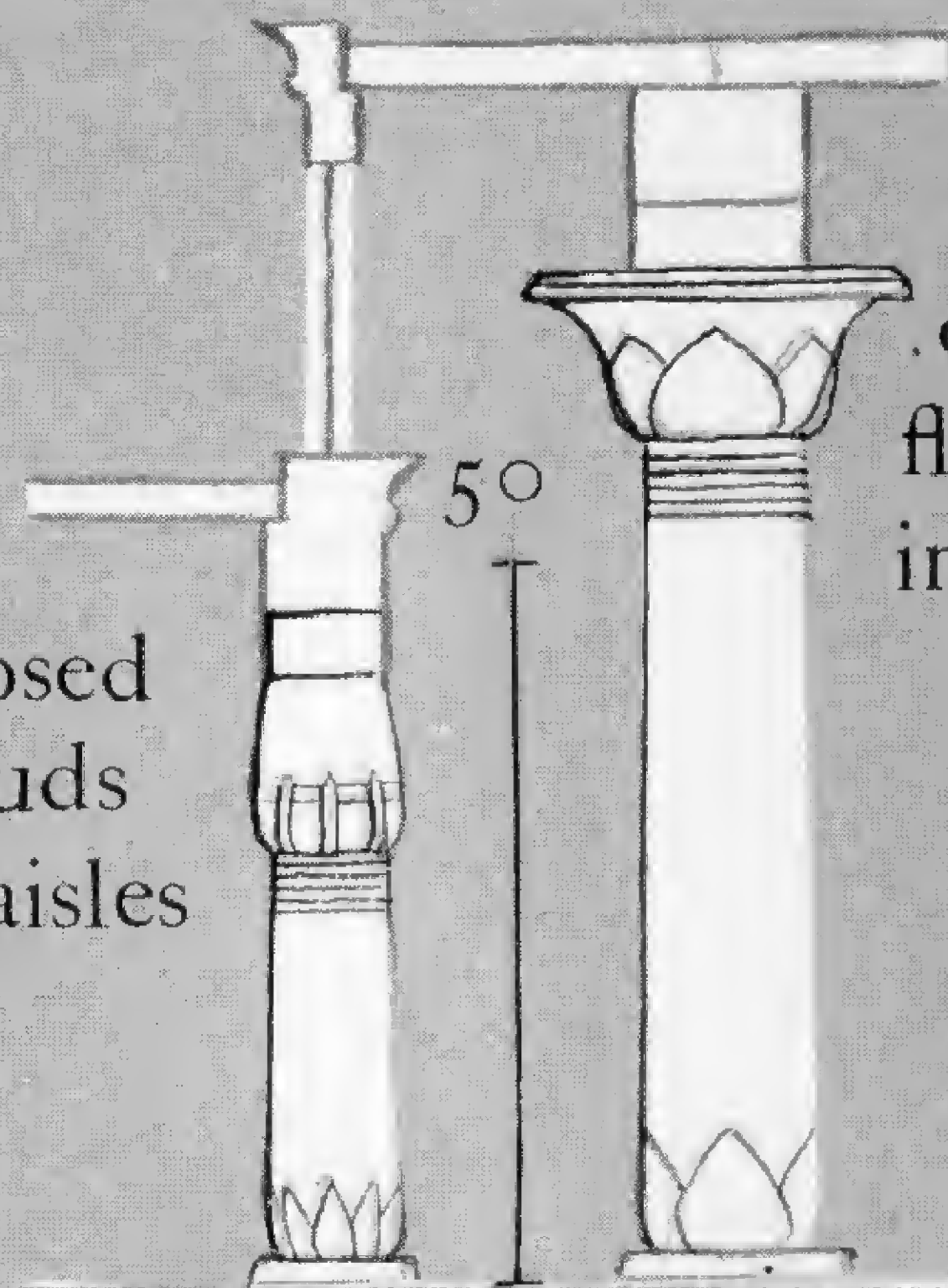
Dynasty V



Temple of Luxor
Dynasty XIX



closed
buds
in aisles



The Great Temple of Amon,
Karnak; Hypostyle Hall,

Dynasty XIX

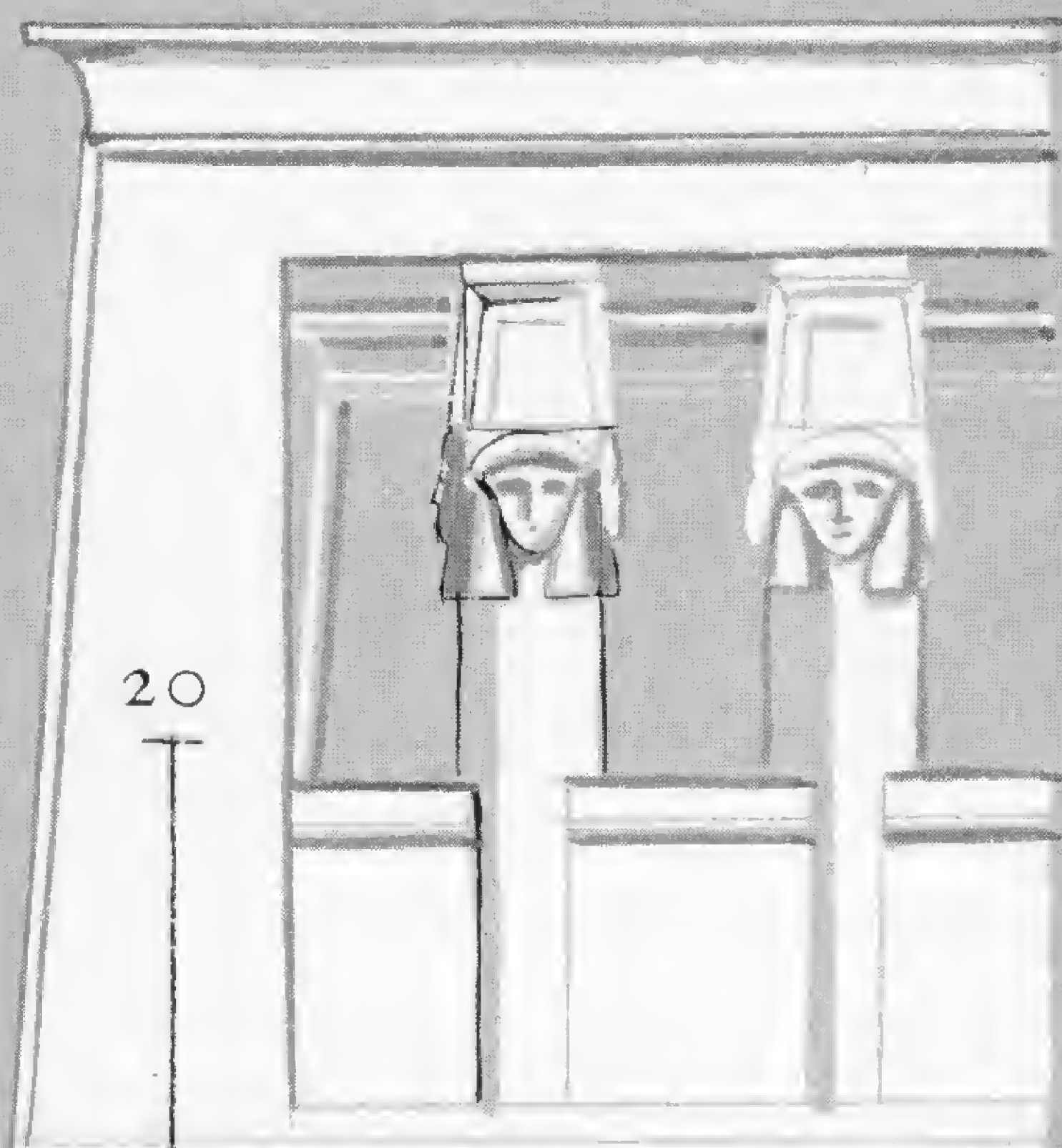
open
flowers
in nave



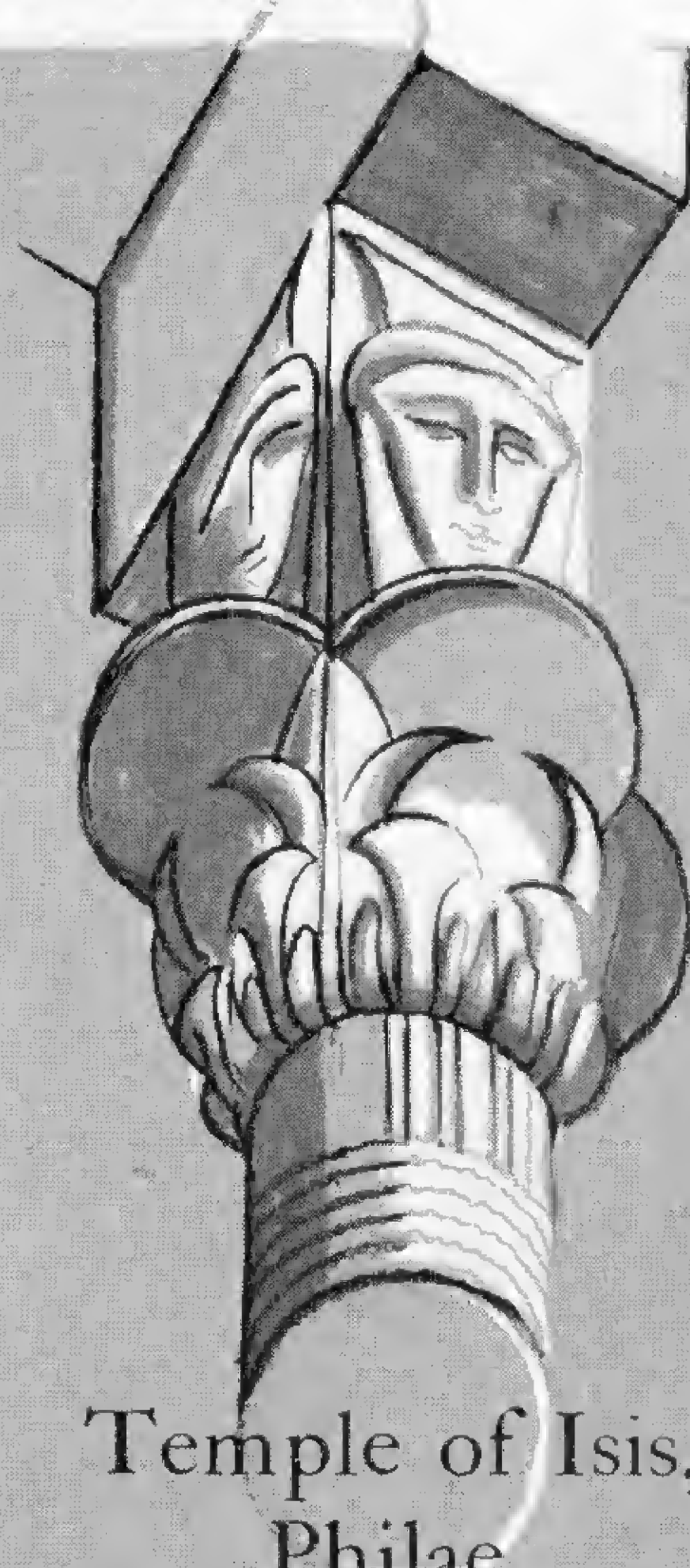
PAPYRUS COLUMNS



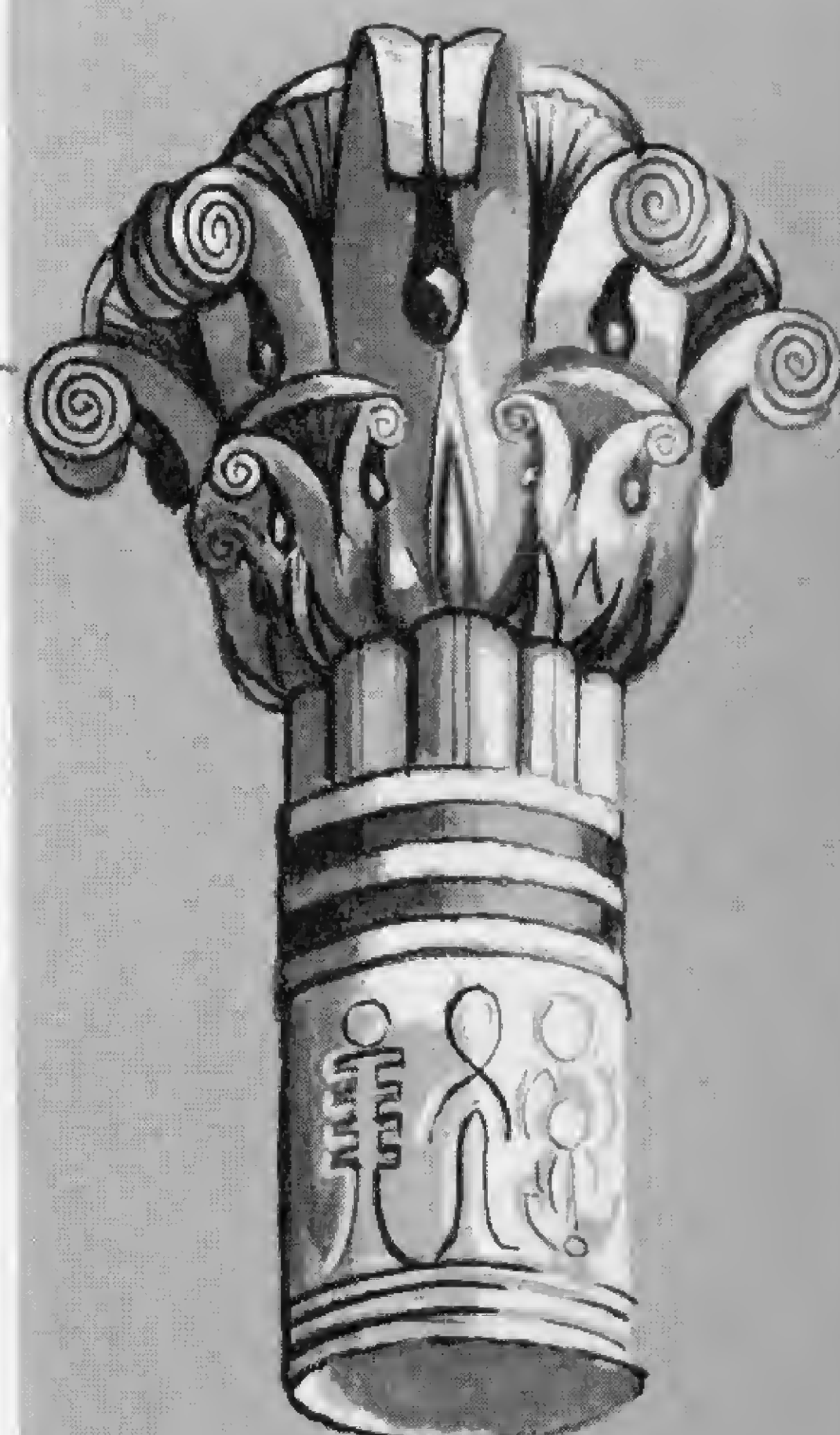
Temple of Hathor, Denderah,
Ptolemaic



20



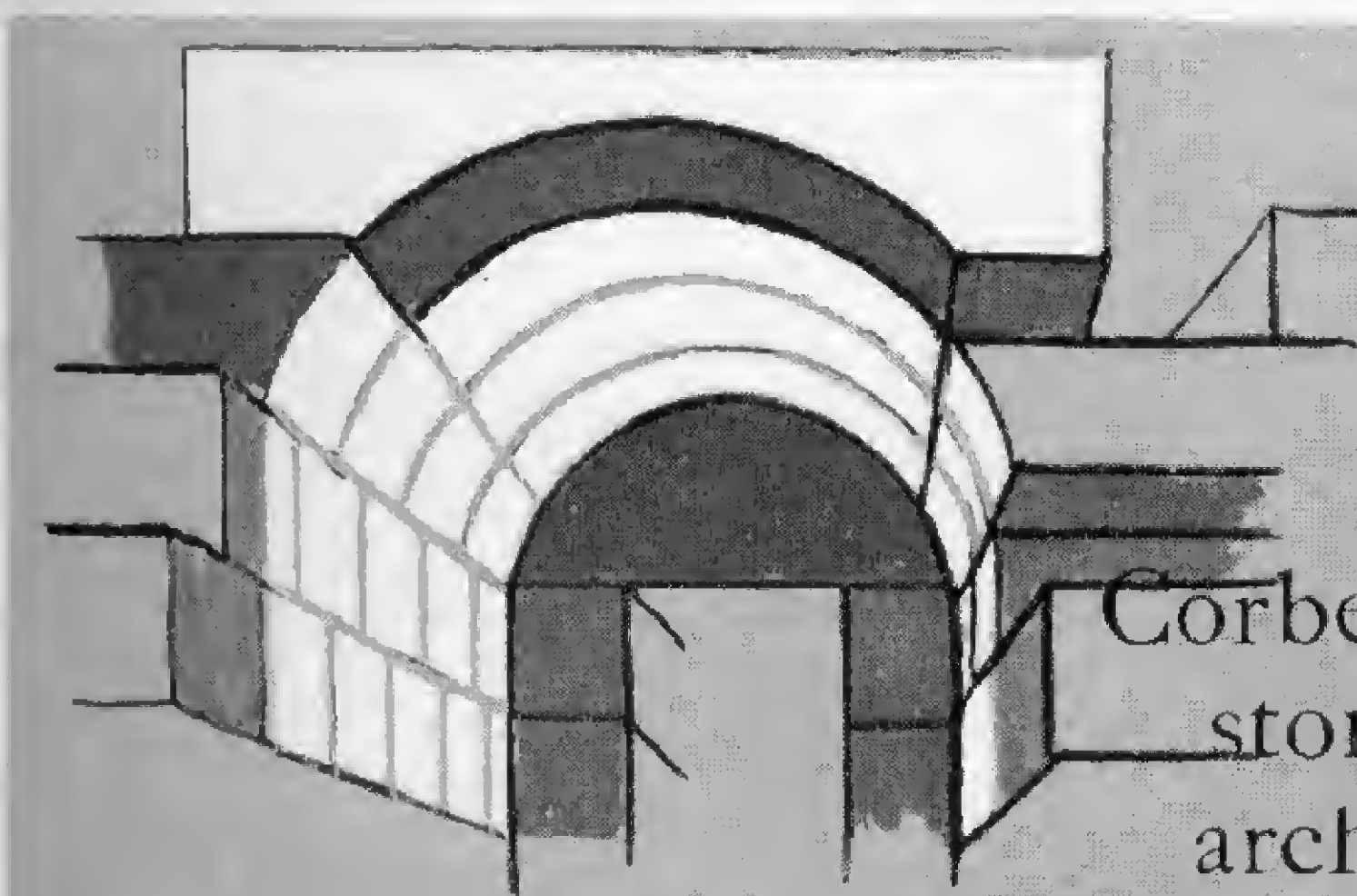
Temple of Isis,
Philae



Ptolemaic

HATHOR-HEADED COLUMNS

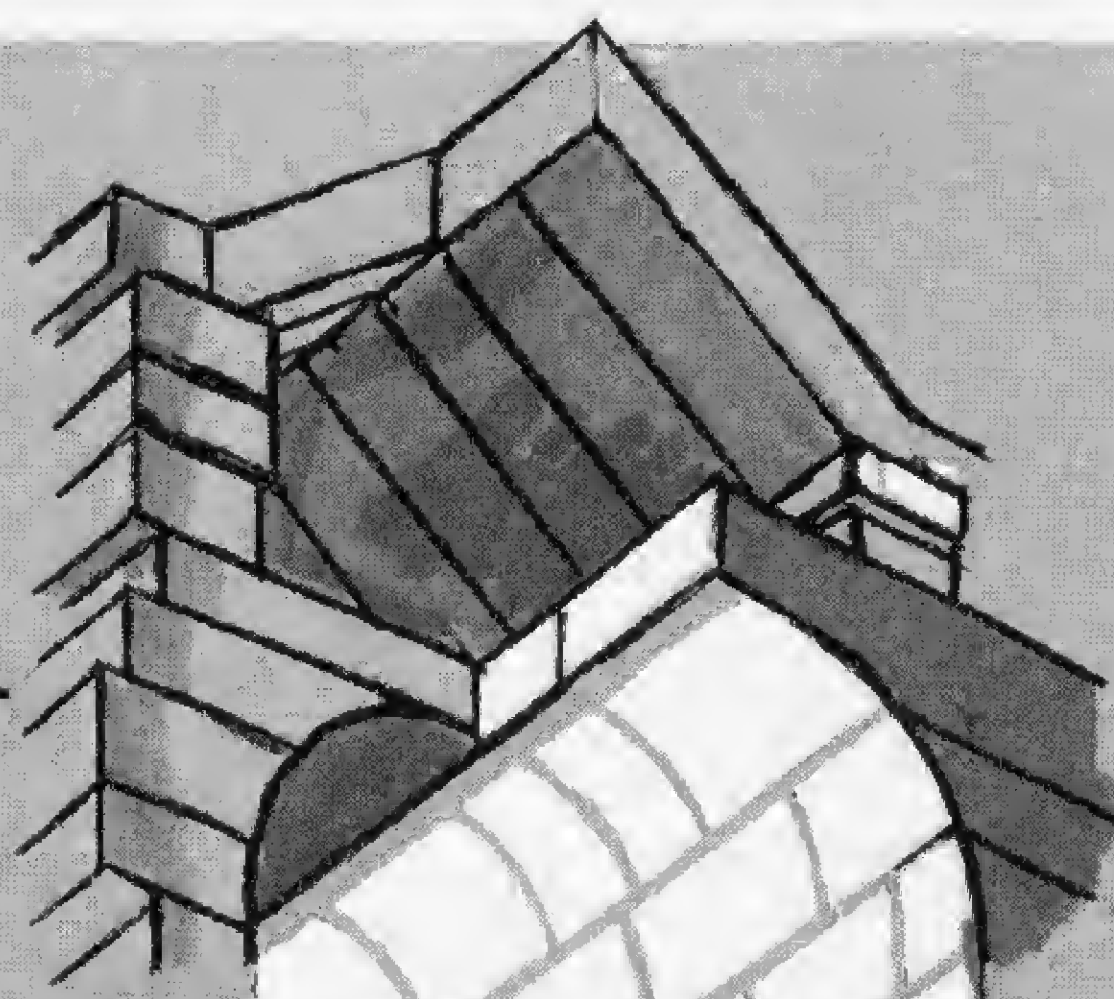
COMPOSITE



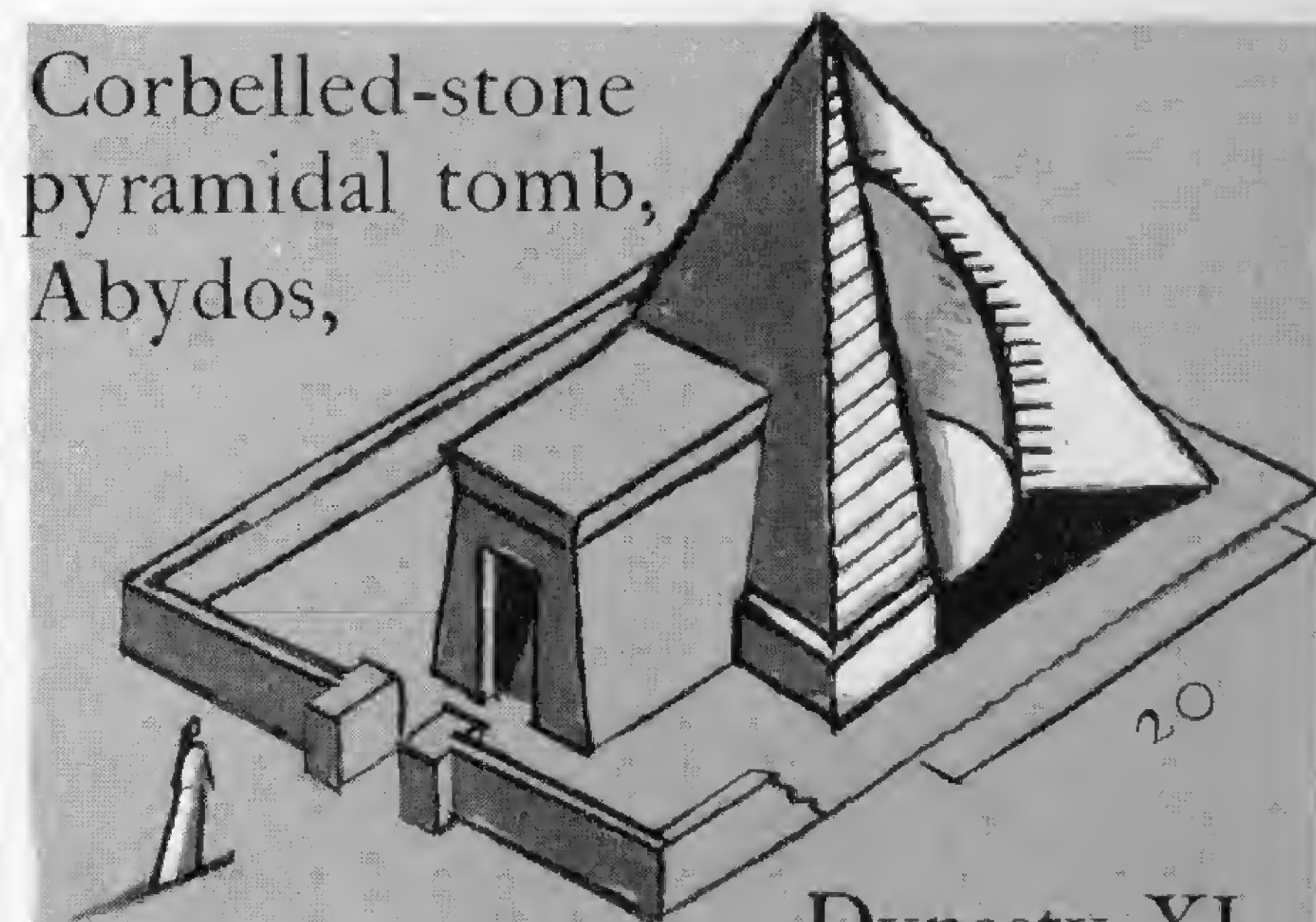
Corbelled-
stone
arches,

Temple-tomb Deir-el-Bahari

Dynasty XIX



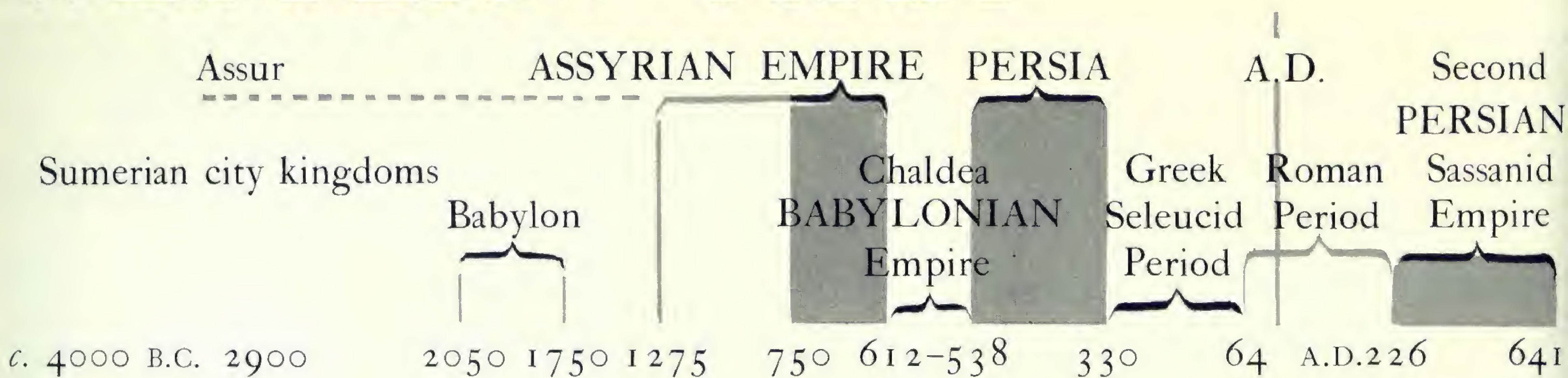
Temple of Seti I, Abydos



Corbelled-stone
pyramidal tomb,
Abydos,

Dynasty XI

WESTERN ASIA



SUMERIAN CITY KINGDOMS

Civilization in Western Asia began with city kingdoms in the rich alluvial plain between the lower Tigris and the Euphrates, an area about that of Wales (Map p. 14). Tower-temples or ziggurats were the centre of city life. There was no stone and little timber but clay was moulded into sun-dried brick. Buildings were faced with kiln-baked bricks, sparingly owing to lack of fuel.

ASSYRIA

Assyria was set on a high tableland of lime-stone, harder rock & alabaster, but the Assyrians continued to use sun-dried and kiln-baked bricks. Palaces of warrior-kings were built on large platforms of brick 30-50 feet high. Lower courses of walls were faced with slabs of alabaster 9-12 feet high and carved with bas-reliefs or covered with plaster and painted with bright colour. The arch was constructed for gateways, vaults and drains.

SECOND BABYLONIAN EMPIRE

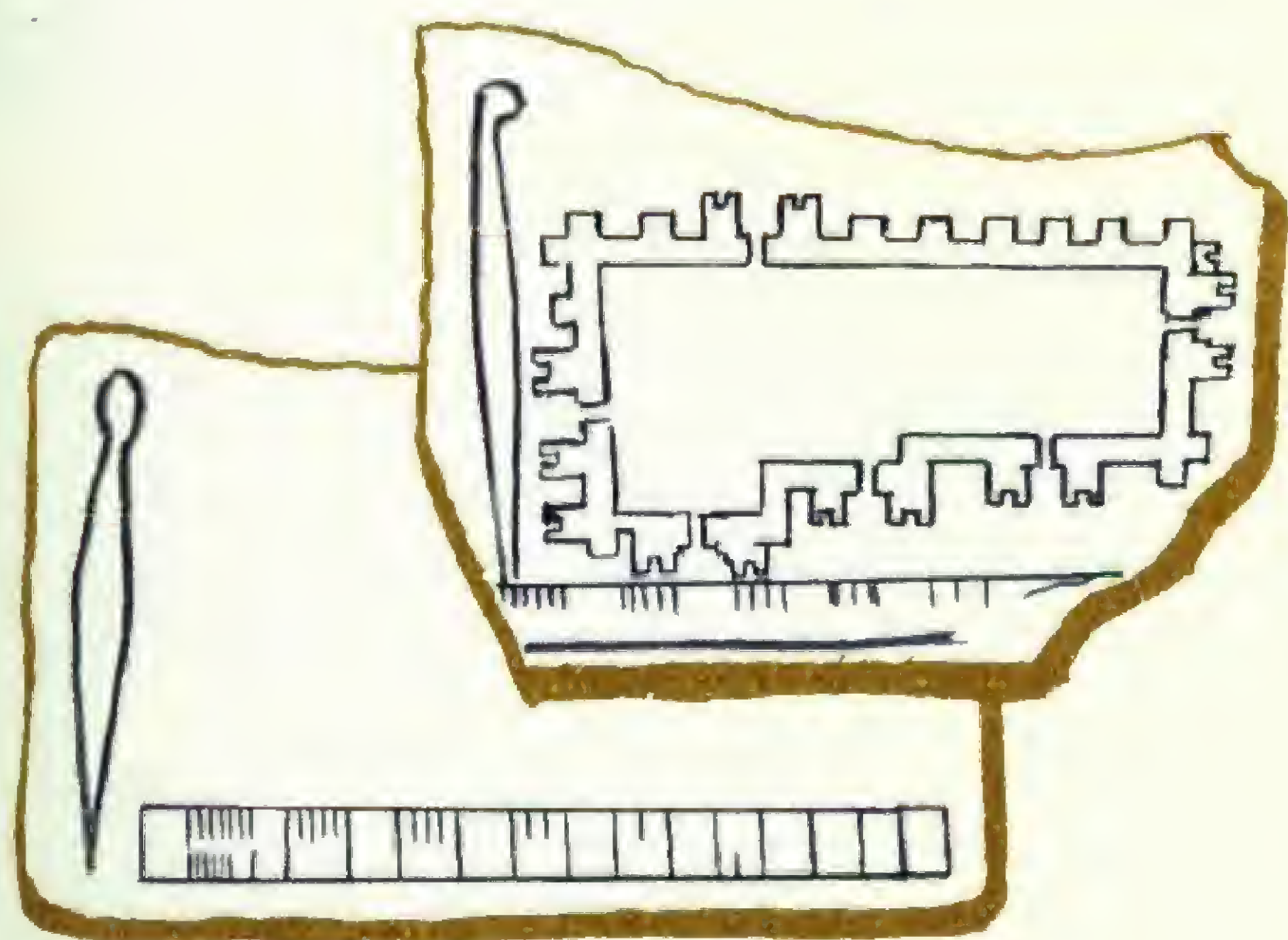
Nebuchadnezzar (604-561 B.C.) rebuilt Babylon to a regular plan described in *The Histories* by Herodotus (484-406 B.C.). Buildings were of kiln-baked brick and bitumen.

PERSIAN EMPIRE

Palaces were built at the capital city of Susa, at Pasargadae and Persepolis, being constructed of stone which was abundant in Persia; whilst raised platforms and glazed coloured bricks were adapted from the Assyrians; also influences from Babylon, Syria and Egypt.

SECOND PERSIAN—SASSANID—EMPIRE

The capital city at Ctesiphon. Buildings were erected of kiln-baked brick, vaults and the earliest domes being built over square compartments, developed by the Byzantines.



Stilus, scale and plan of King Gudea of Lagash, c. 2350 B.C.

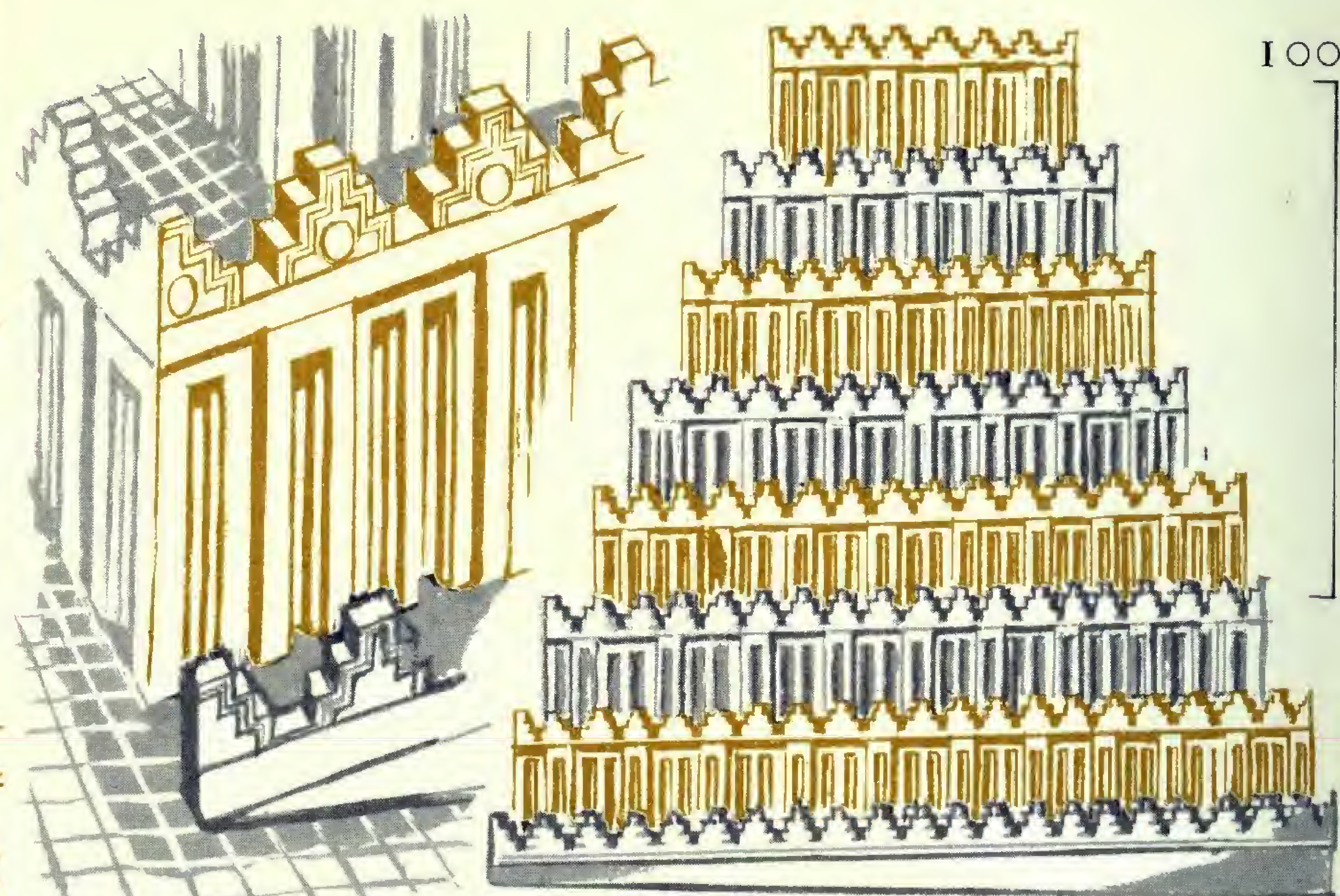
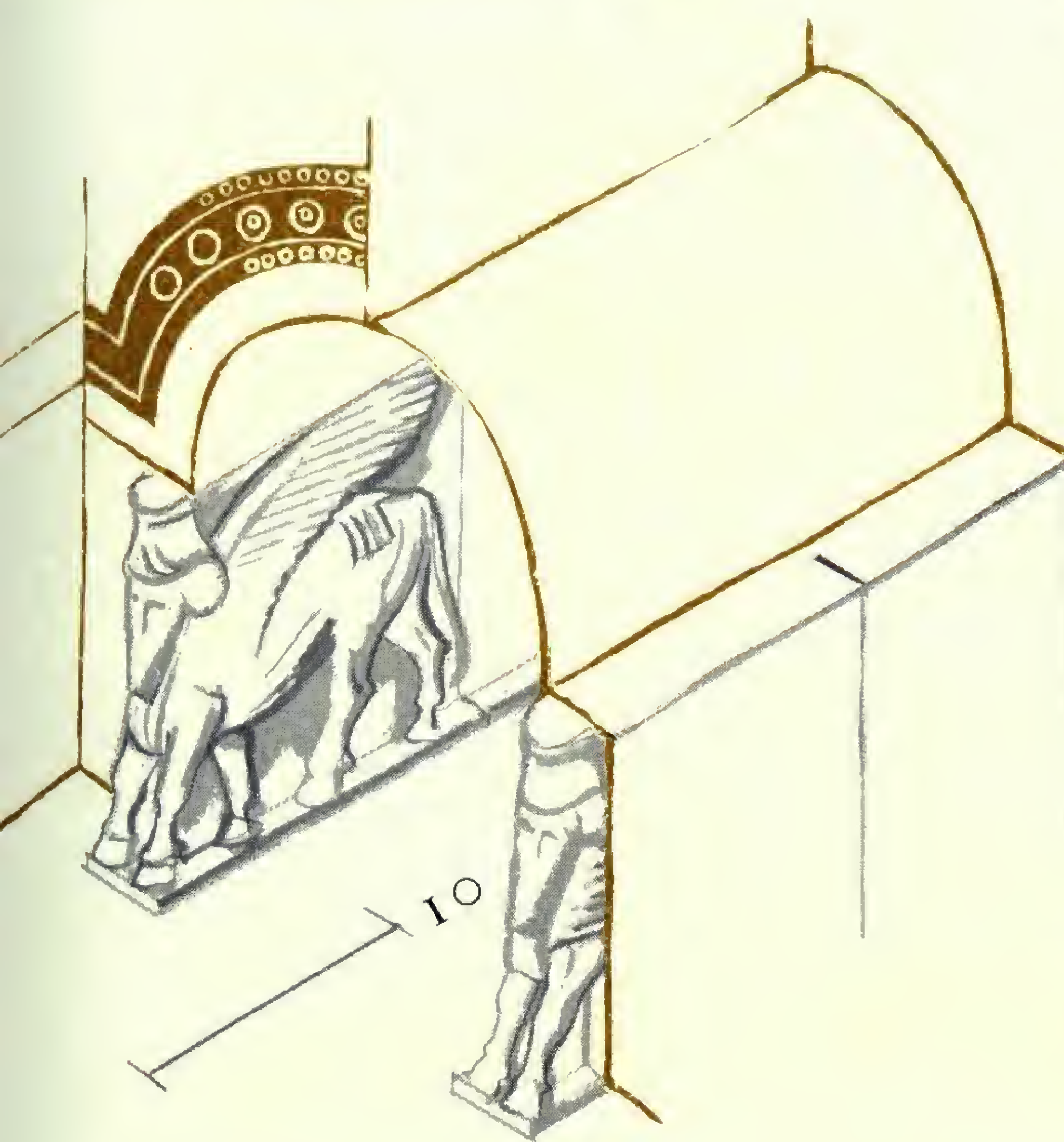
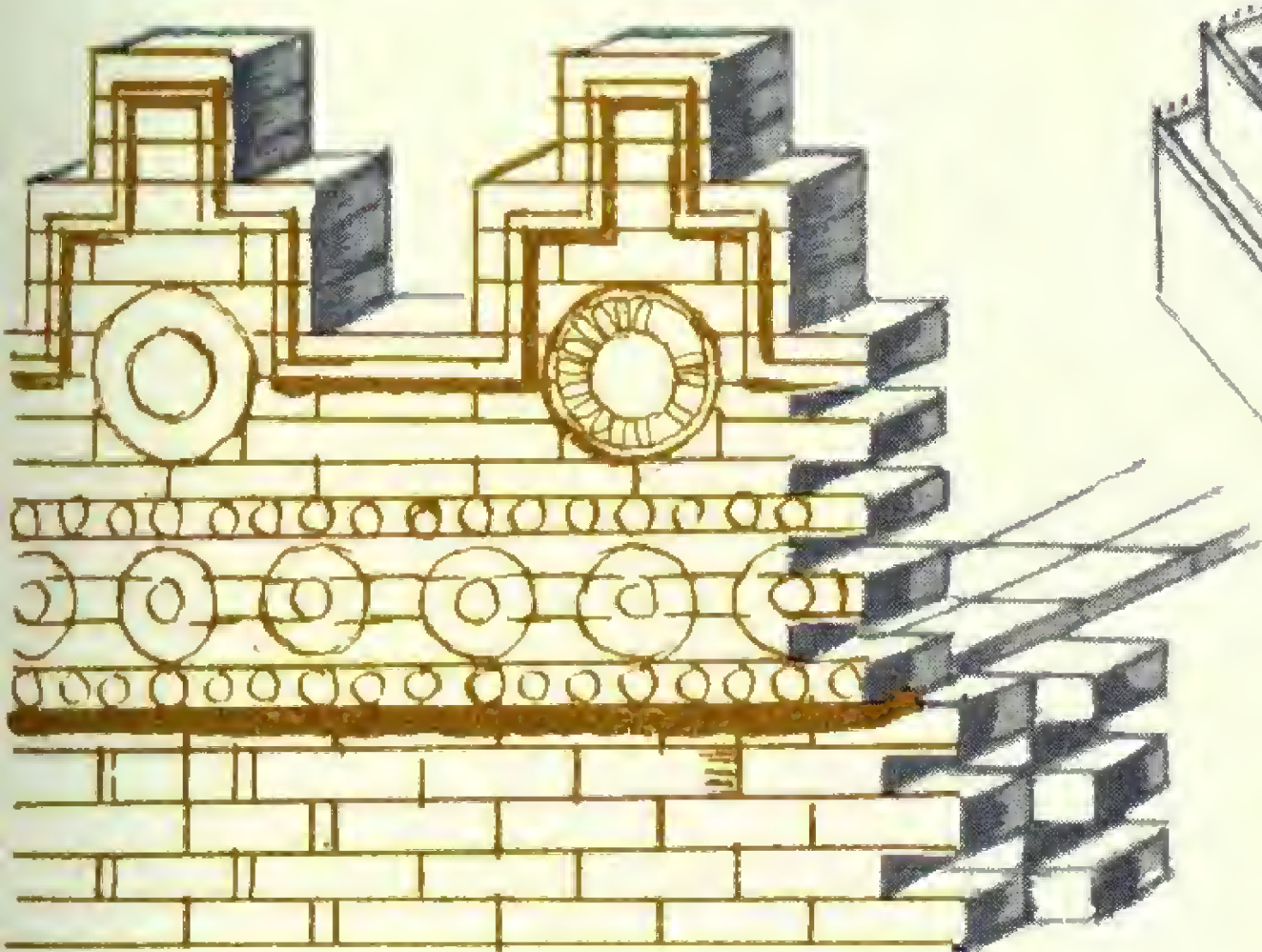


The Ziggurat, Ur (restored), c. 2350 B.C.

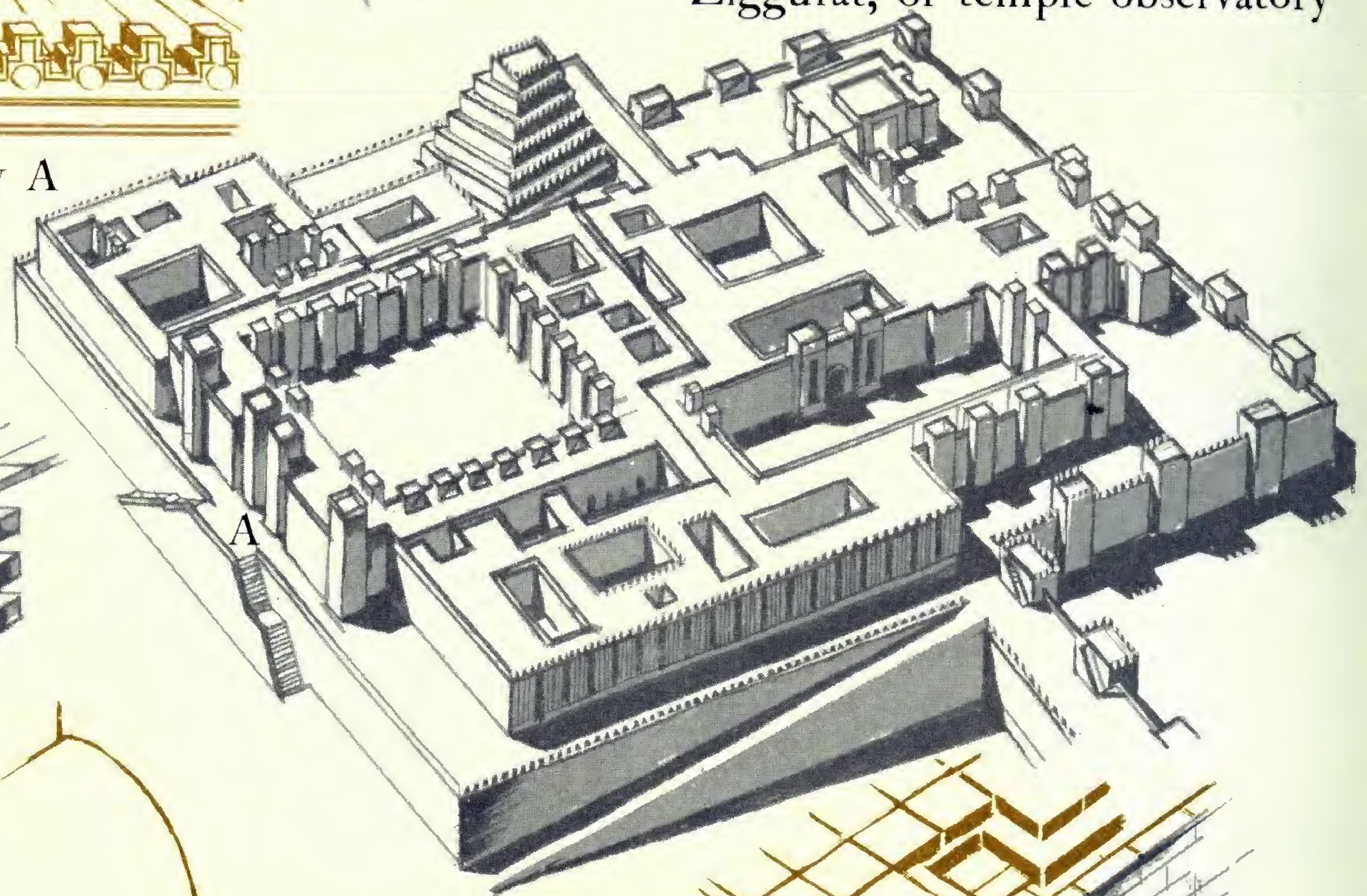
INTRODUCTION - ASSYRIA



South-east gateway A



Ziggurat, or temple observatory

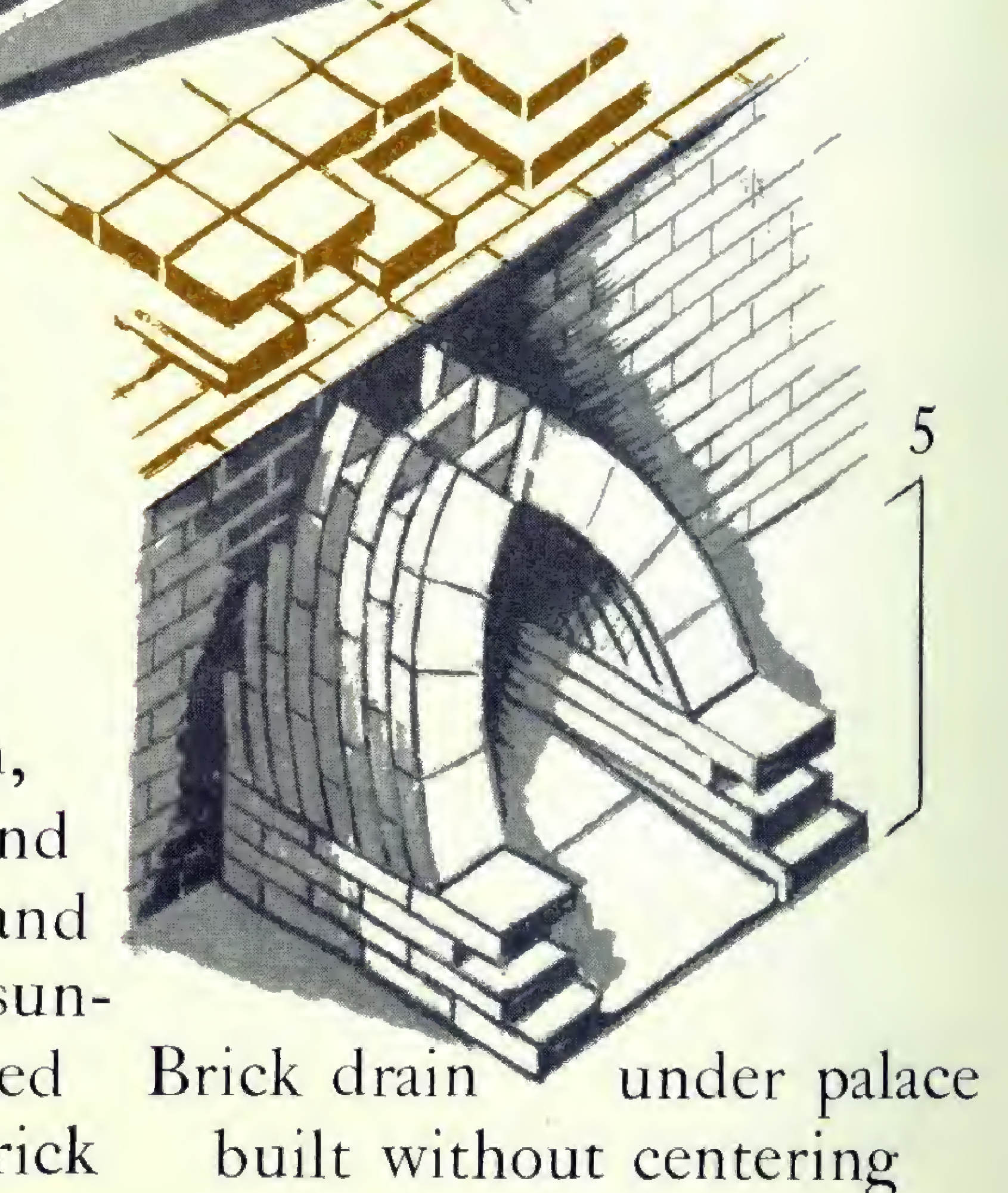


PALACE OF SAGON II KHORSABAD

(restored)

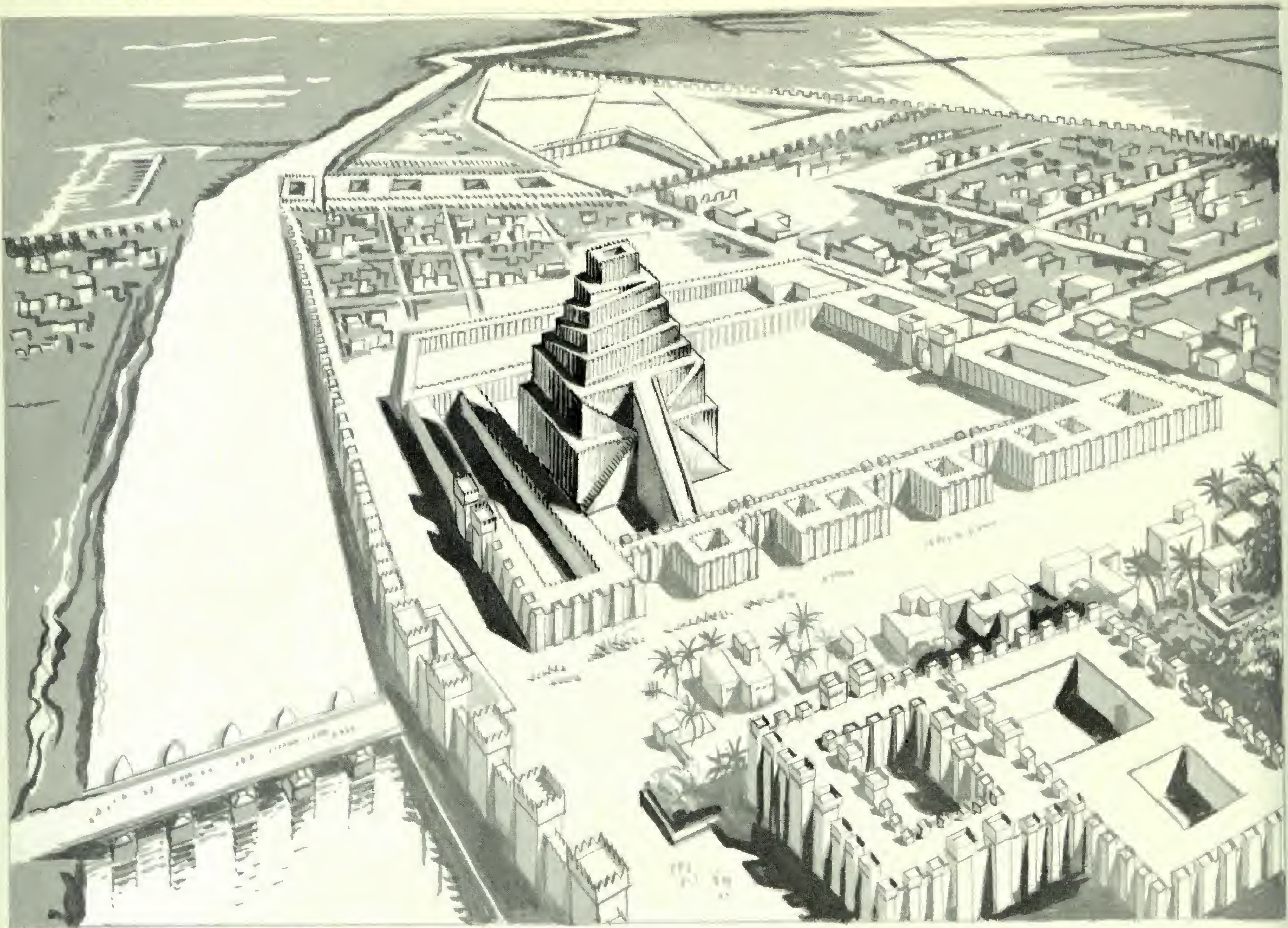
772-705 B.C.

Both the platform,
about 50 ft high and
25 acres in extent, and
the palace built of sun-
dried brick and faced
with kiln-baked brick



Brick drain under palace
built without centering

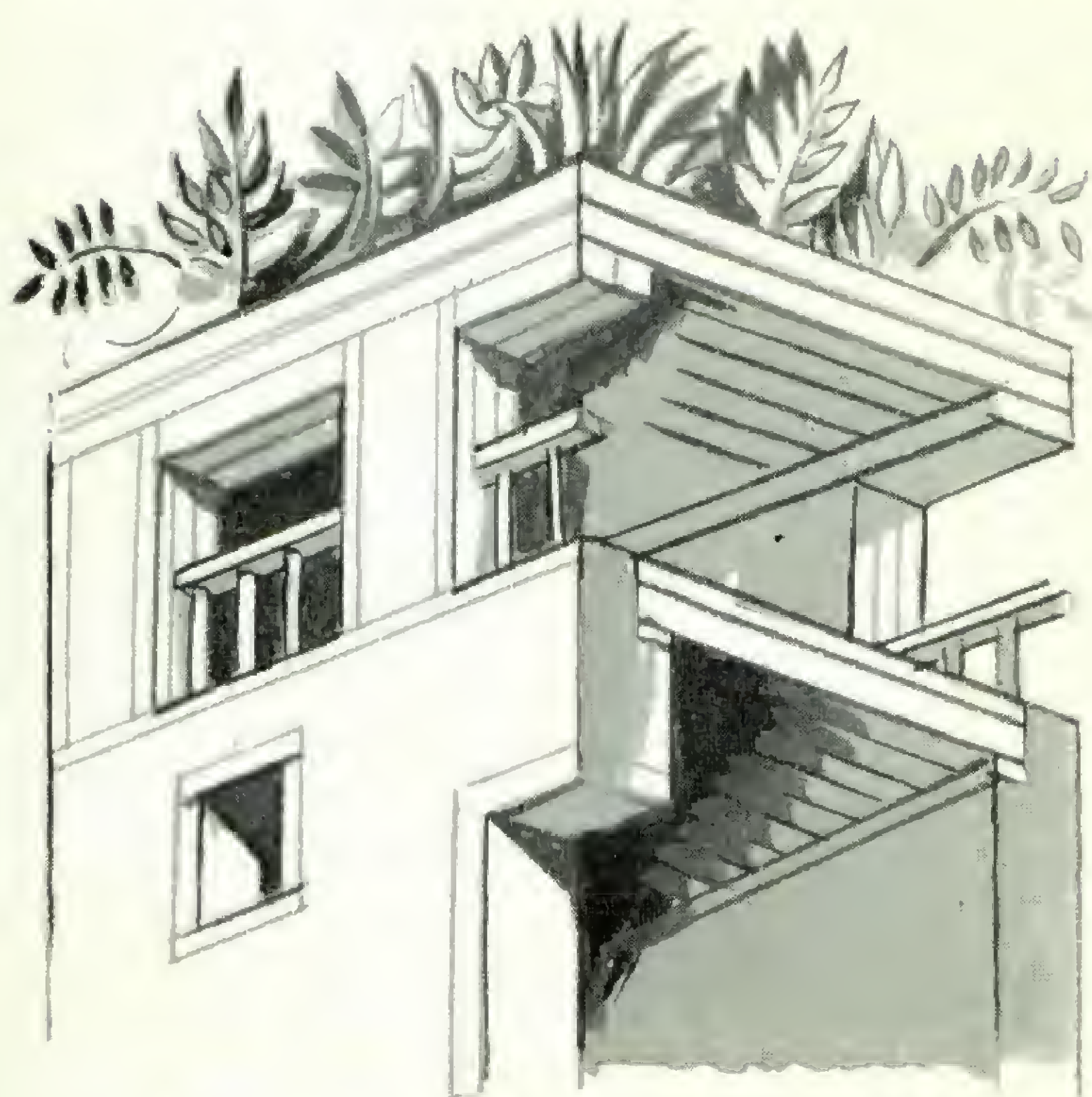
WESTERN ASIA BABYLON



THE CITY OF BABYLON (reconstructed),

as rebuilt by Nebuchadnezzar,
604-561 B.C., during the Second
Babylonian Empire.

Described in *The Histories* of Herodotus



House with roof-garden



Hall of 100 columns, Darius

Palace of Xerxes

Palace of Darius

Hypostyle

Hall of Xerxes

Propylae of Xerxes

THE PALACES OF PERSEPOLIS

(reconstructed),

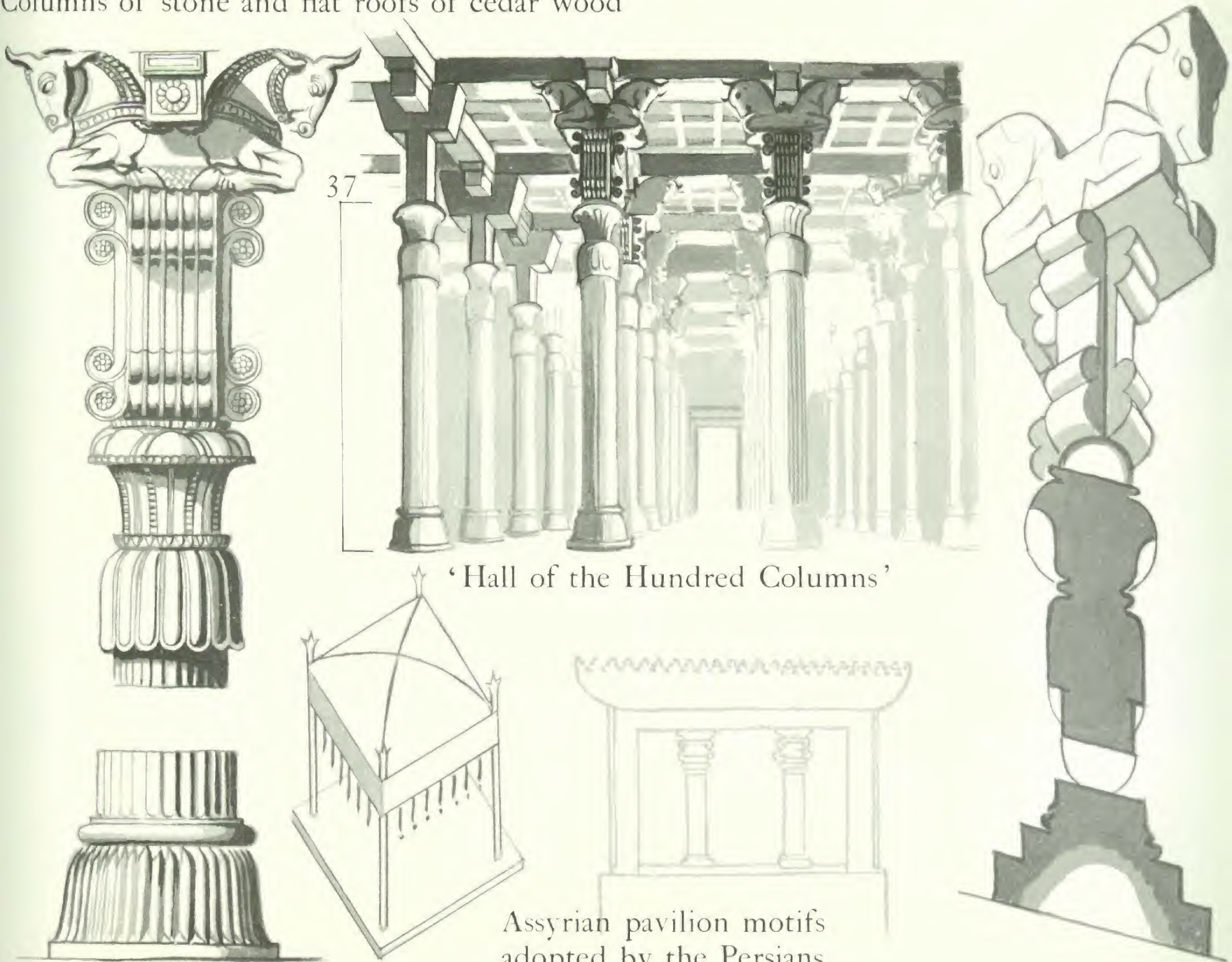
Built by Darius (521-485 B.C.) and Xerxes (485-465 B.C.)

Built on a platform 1500 ft by 1000 ft in area, and 40 ft above

the plain, part solid rock, part large blocks of stone, without mortar,

held by metal cramps. Buildings constructed of sun-dried brick and faced with glazed bricks.

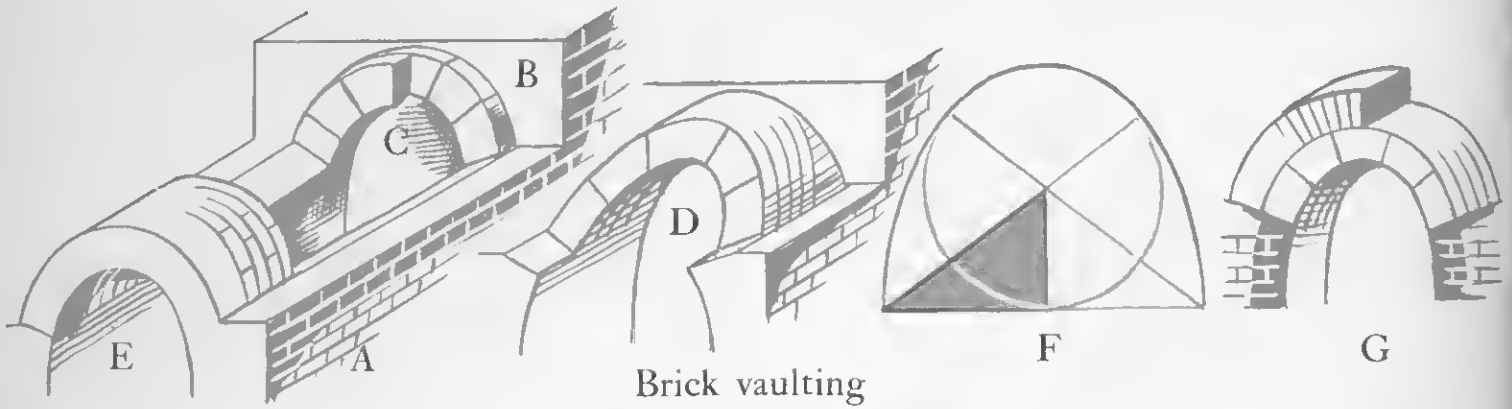
Columns of stone and flat roofs of cedar wood



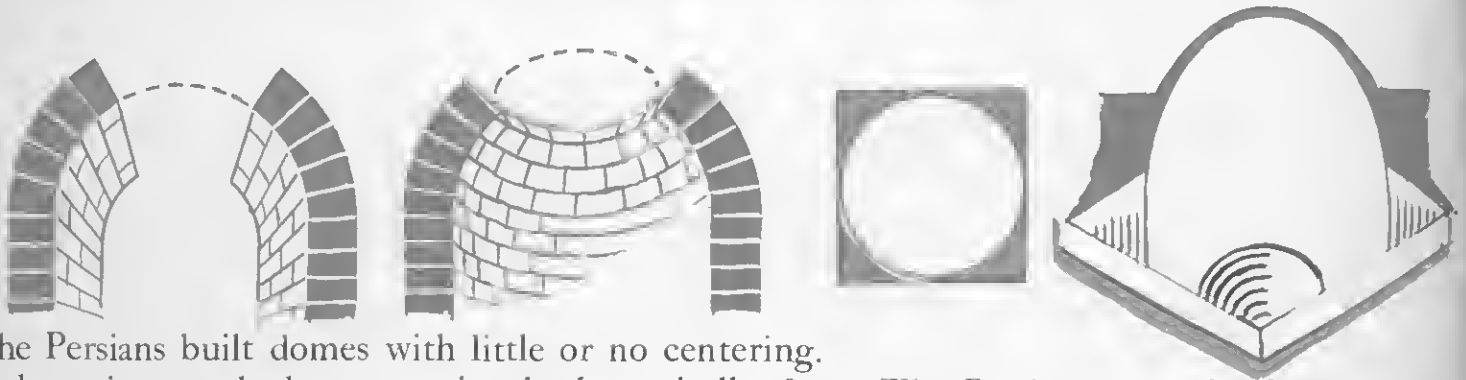
'Hall of the Hundred Columns'

Assyrian pavilion motifs adopted by the Persians

WESTERN ASIA VAULTS &

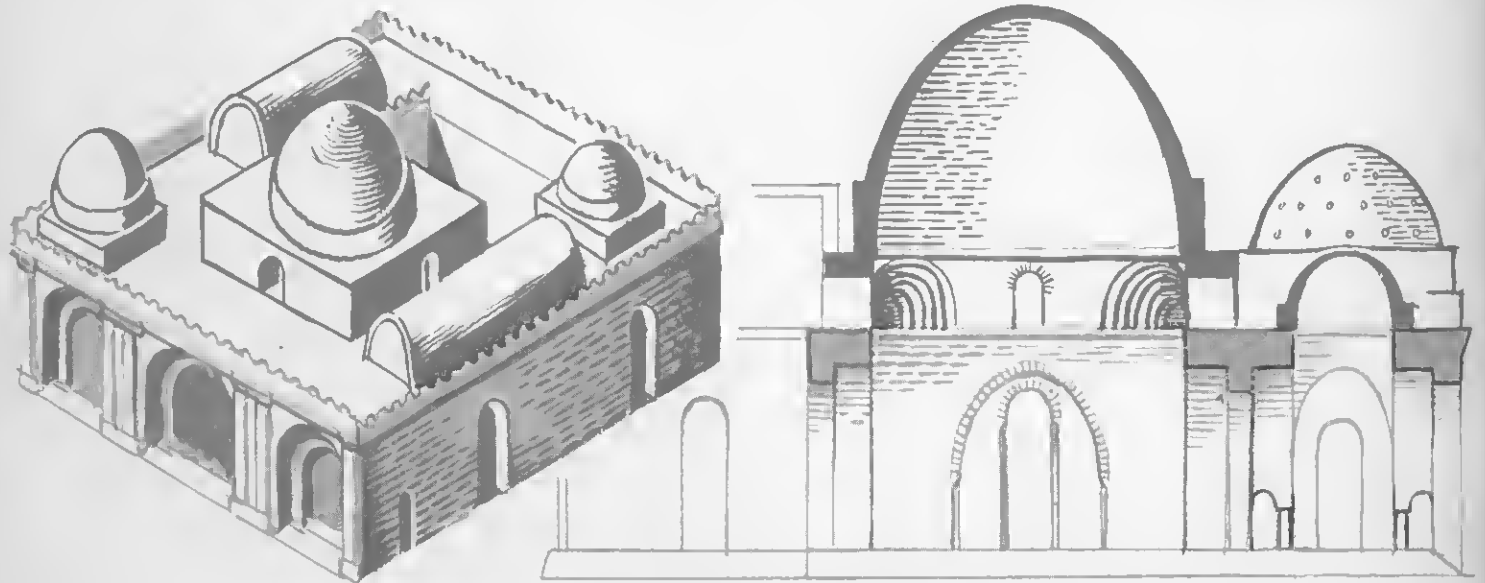


Bricks were laid to form a base A; against an end wall B wedge-shaped bricks were fixed with mortar C. To ensure adherence these were often laid in sloping courses D. An arch was constructed with little or no centering to complete the vault E. To facilitate work and to reduce pressure, vaults (and domes) had a high oval profile F. When completed vaults were often re-inforced by a second or more courses of brick G. Sassanid Persian buildings, vaults and domes were constructed of kiln-baked bricks laid with a mortar of lime and sand



The Persians built domes with little or no centering. A dome is an arched construction both vertically & horizontally: each ring of brick or stone once closed in cannot fall if it rests adequately on the ring below

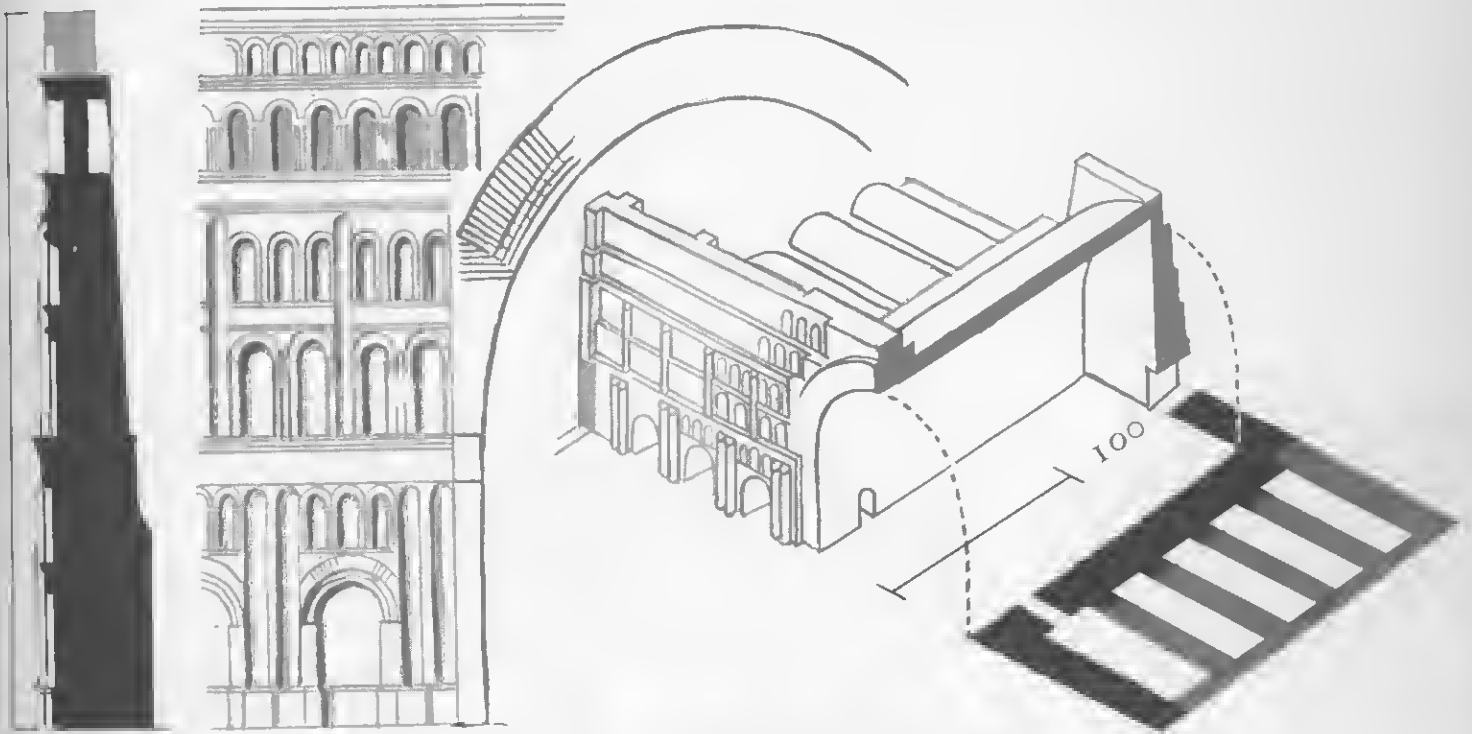
The Persians were the first to erect circular domes on square plans with four angular corbelled semi-domes



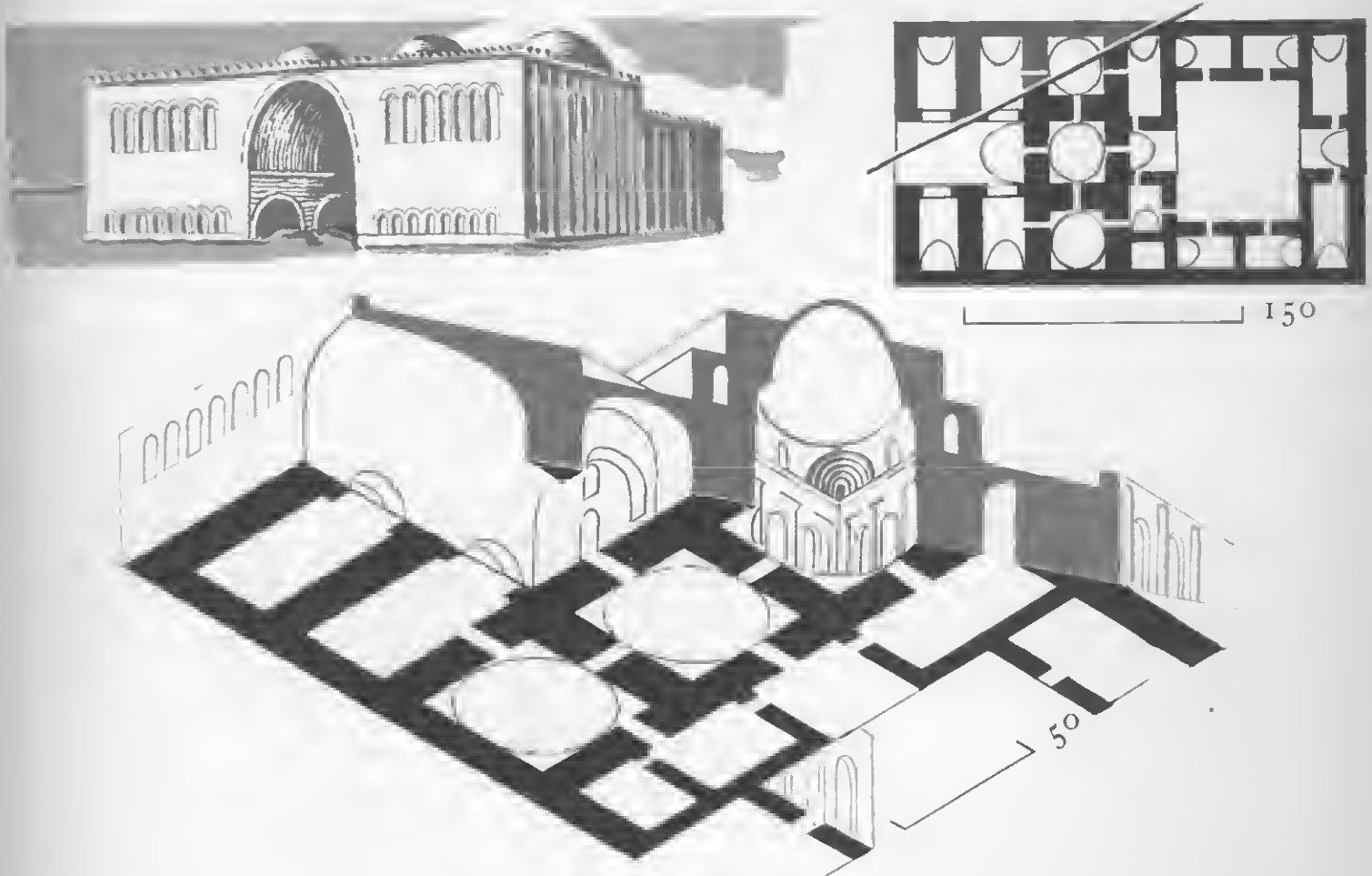
The Palace, Serpistan (exterior restored), c. A.D. 350

DOMES - SECOND PERSIAN EMPIRE

1125



The Palace of Chosroes, Ctesiphon, 6th cent. A.D.

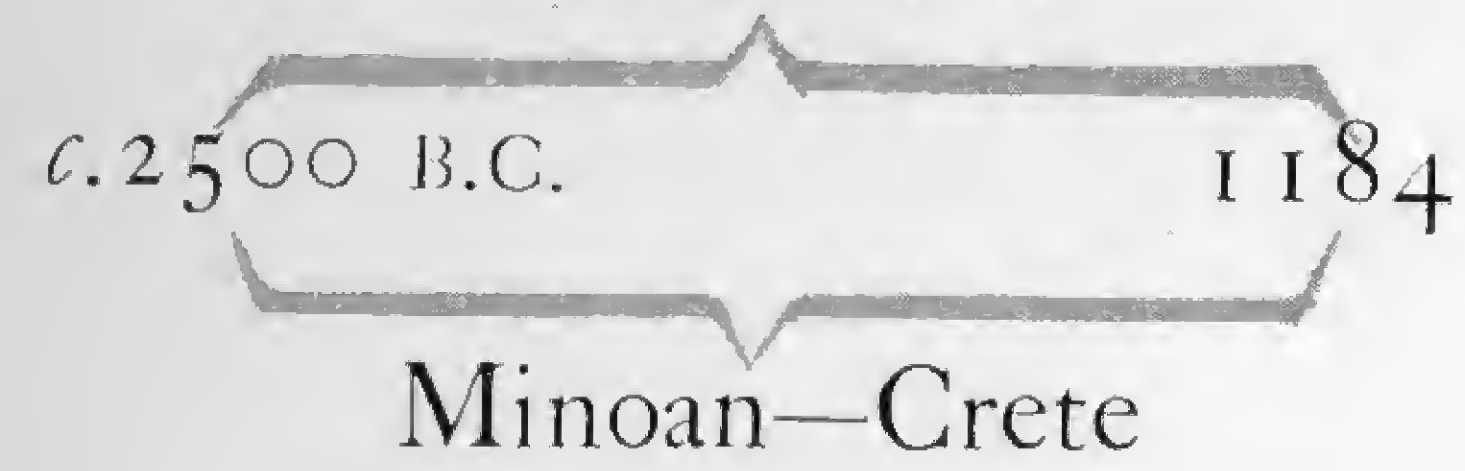


The Palace, Firouzabad (exterior restored), c. A.D. 450

GREEK

AEGEAN

HELLENIC



775/6
First
Olympiad

650

500

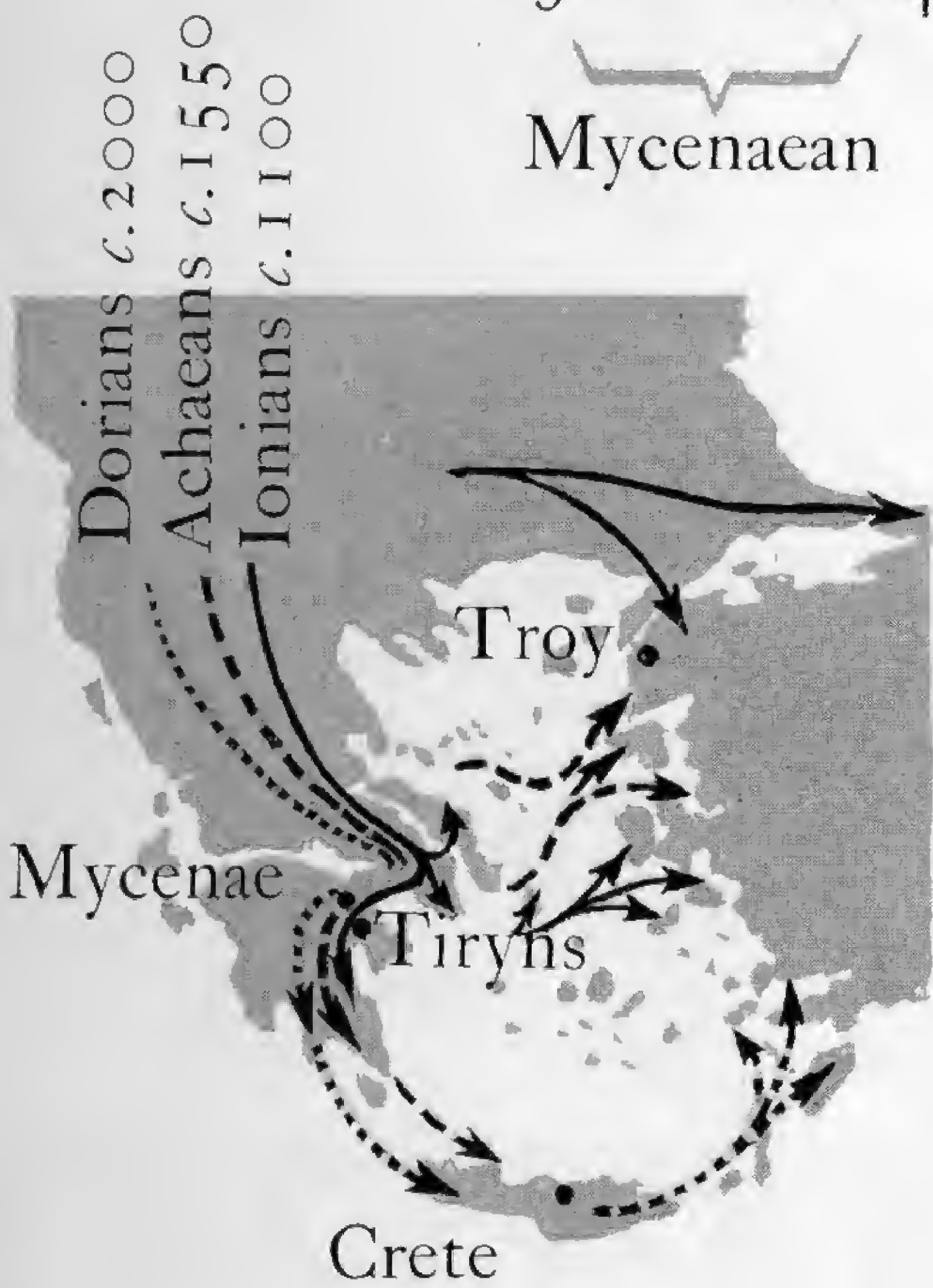
Archaic period

Establishment of Greek city-states
along the Mediterranean and Black Sea

1500 1184
Mycenaean

c.835 Homer

c.582 Pythagoras c.510



The Greek invasions

Greek colonisation 8th-6th centuries B.C.

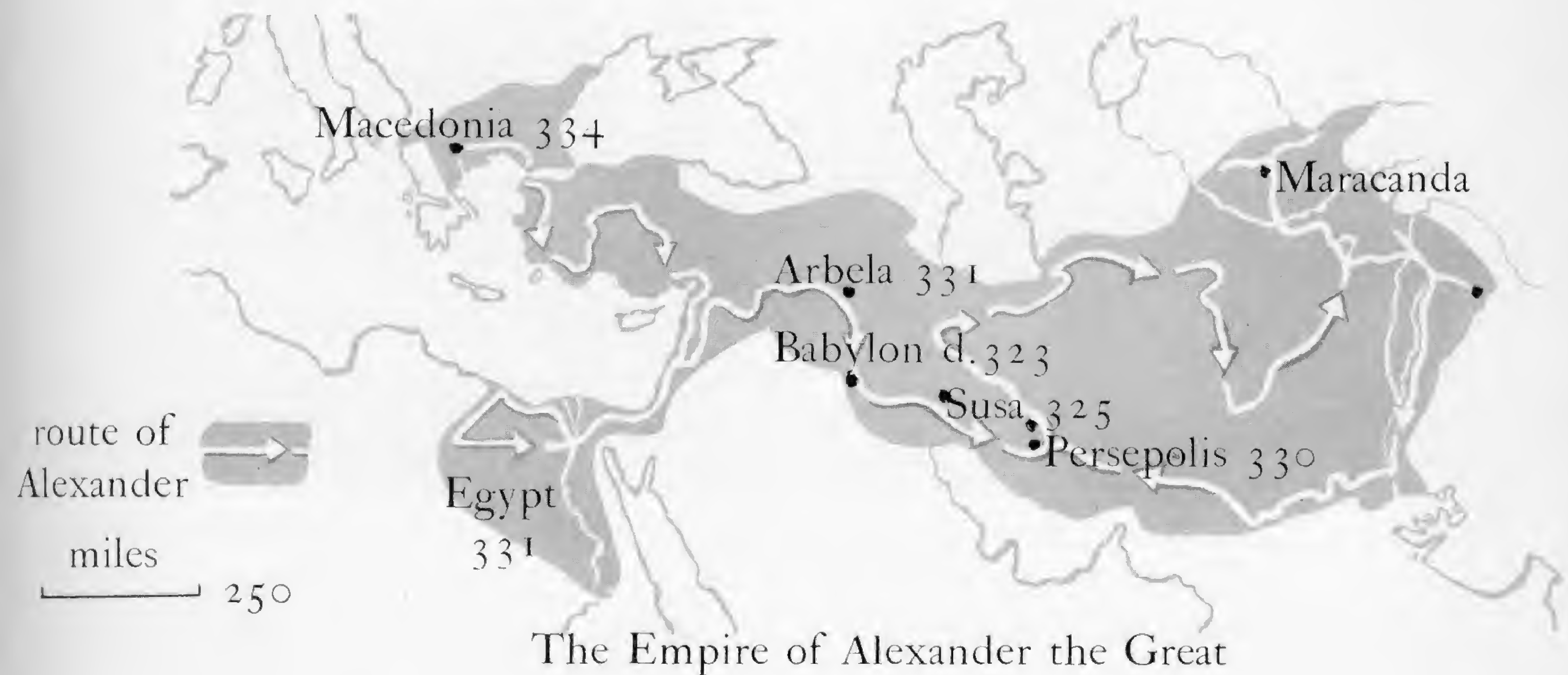


100 miles

INTRODUCTION

HELLENISTIC

492-479	444-429	334-323	146	31 B.C.
War with Persia	Ascendancy of Athens	Alexander the Great King of Macedon	Greece a Roman province	
	431 — 404			
	Peloponnesian War	323 <u>Euclid</u> 283		
	429/8 <u>Plato</u> 347			
	384 <u>Aristotle</u> 332			



The Aegean Period. 1 No records survive of the Minoan sea-kings of Crete except remains of palaces, e.g. Cnossus. 2 The Mycenaeans built massive citadels with Cyclopean masonry and domed tholos tombs on the mainland. The Aegean civilization fell before the Homeric Greeks.

The Hellenic Period. The Greeks called themselves Hellenes (Hellas was called Graecia by the Romans). They formed numerous small city states in which primitive houses surrounded a citadel and later a temple built on an acropolis or upper city. National unity was achieved by pan-Hellenic festivals held at Olympia, Delphi, Argos and Corinth every few years.

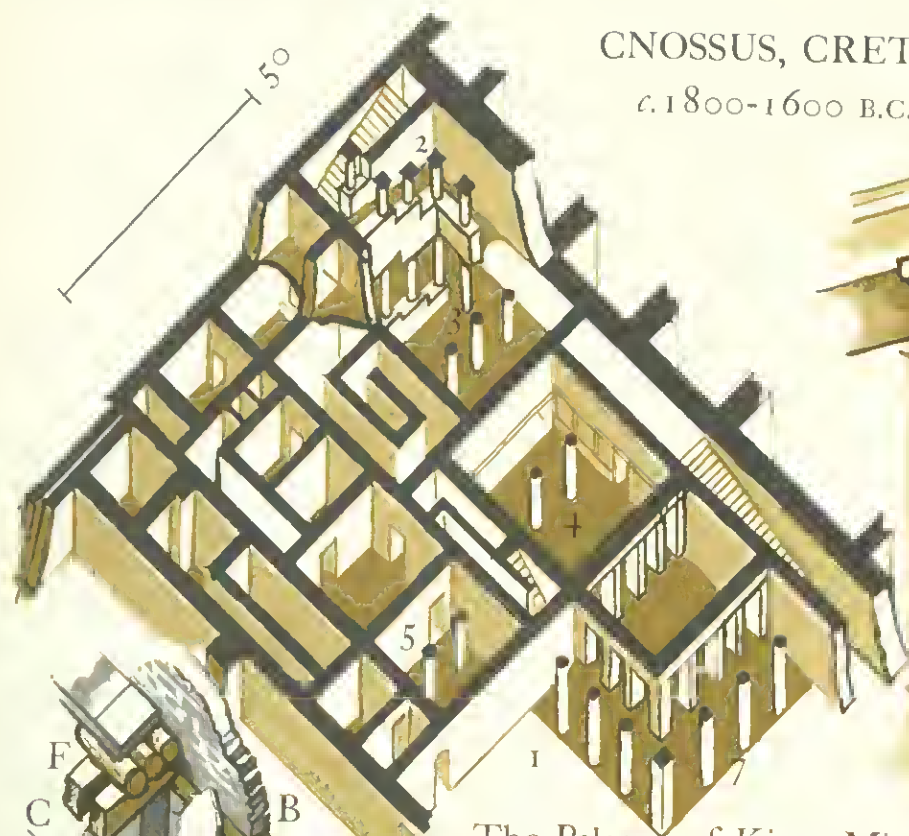
The Hellenistic Period began with the Empire created by Alexander the Great when many new cities were founded with monumental buildings.

The Greek temple developed from the Mycenaean megaron built of sun-dried brick, stone and timber to house a deity and to be looked at from outside, not to contain a congregation within. The arch was known to the Greeks, but they based their temples on the column & beam. These developed from the 6th-4th centuries B.C., each with its own ratios of proportions established by experience. Columns were often placed closer than necessary to support the entablature in order to create a repetitive rhythm of solids and voids. Optical refinements displaying an appearance of vitality and strength have been measured in a number of them. Many architects wrote treatises about their buildings, cited by Vitruvius (1st cent. B.C.) who classified their plans and proportions.

GREEK

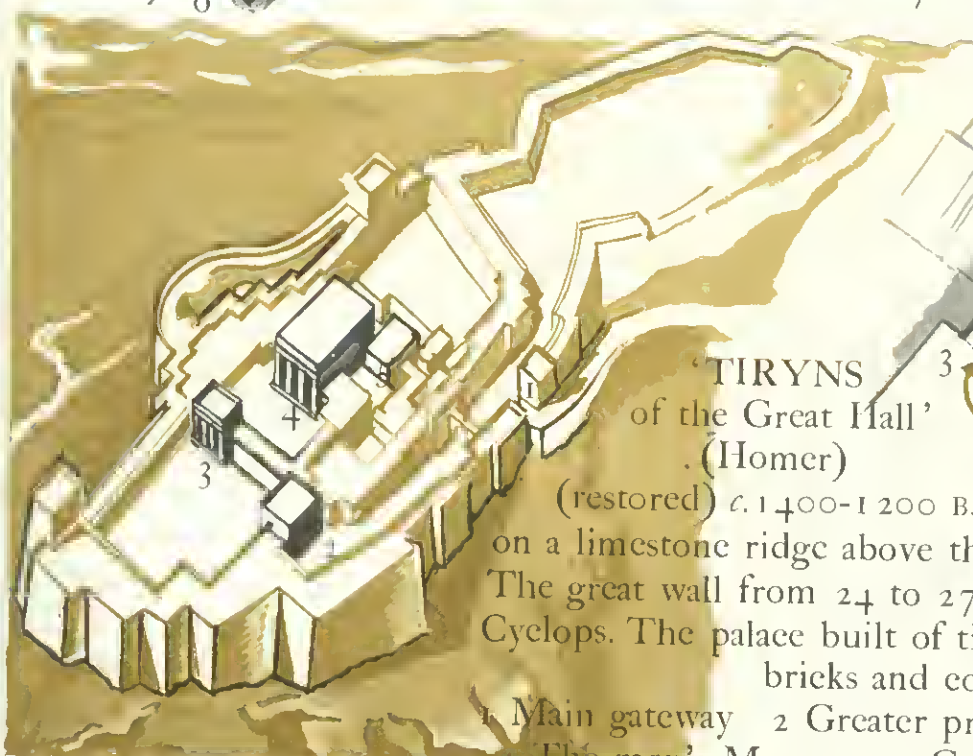
CNOSSUS, CRETE

c. 1800-1600 B.C.



The Palace of King Minos (restored), c. 1800-1600 B.C.

1 The King and Queen's apartments 2 Great staircase 3 Hall of the Colonnade 4 Hall of the Double Axes 5 Queen's Megaron or Hall 6 Construction: A timber framework B sun-dried brick or rubble masonry C gypsum slabs or D plaster painted with frescoes E plinth and floor of gypsum or limestone F ceiling beams 7 Cypress columns



TIRYNS 'of the Great Hall' (Homer)

(restored) c. 1400-1200 B.C.

on a limestone ridge above the plain of Argos. The great wall from 24 to 27 ft wide ascribed to the Cyclops. The palace built of timber bricks and columns of wood

1 Main gateway 2 Greater propylaeum 3 Lesser propylaeum 4 The men's Megaron or Great Hall 5 The women's Hall

THE AEGEAN

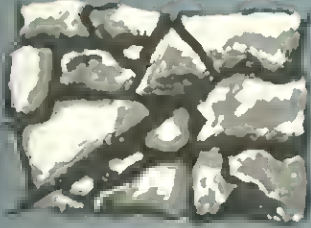


MYCENAE (restored), c. 1350 B.C.

The citadel palace of Agamemnon, Cyclopean walls of boulders weighing 5 to 6 tons were eased into alignment on pebbles



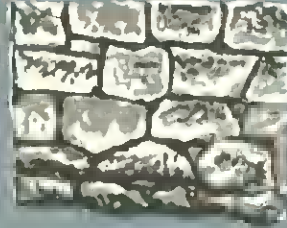
Lion Gate, Mycenae, c. 1200 B.C.



Cyclopean wall, Tiryns



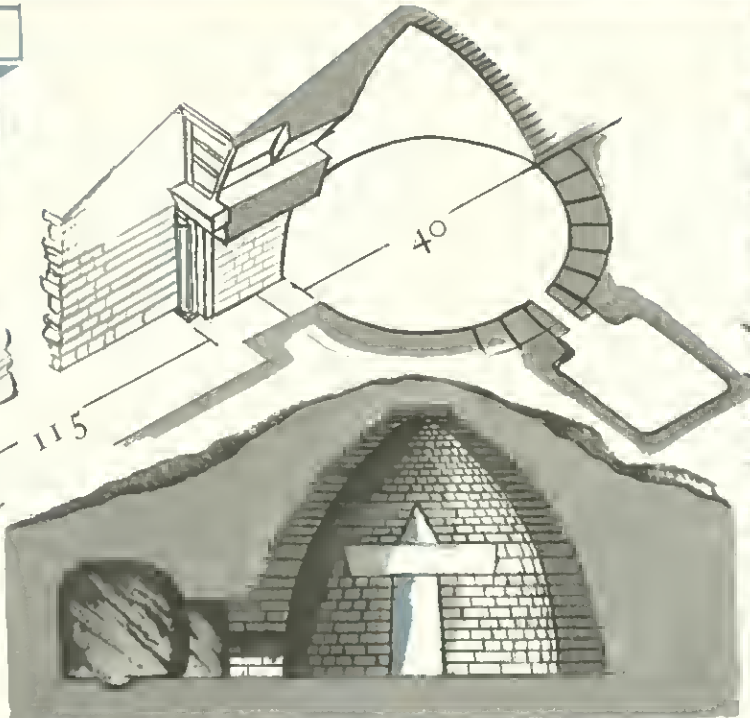
Polygonal, Mycenae



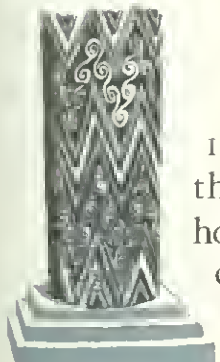
Curvilinear, 7th cent



Rectangular, 5th cent.



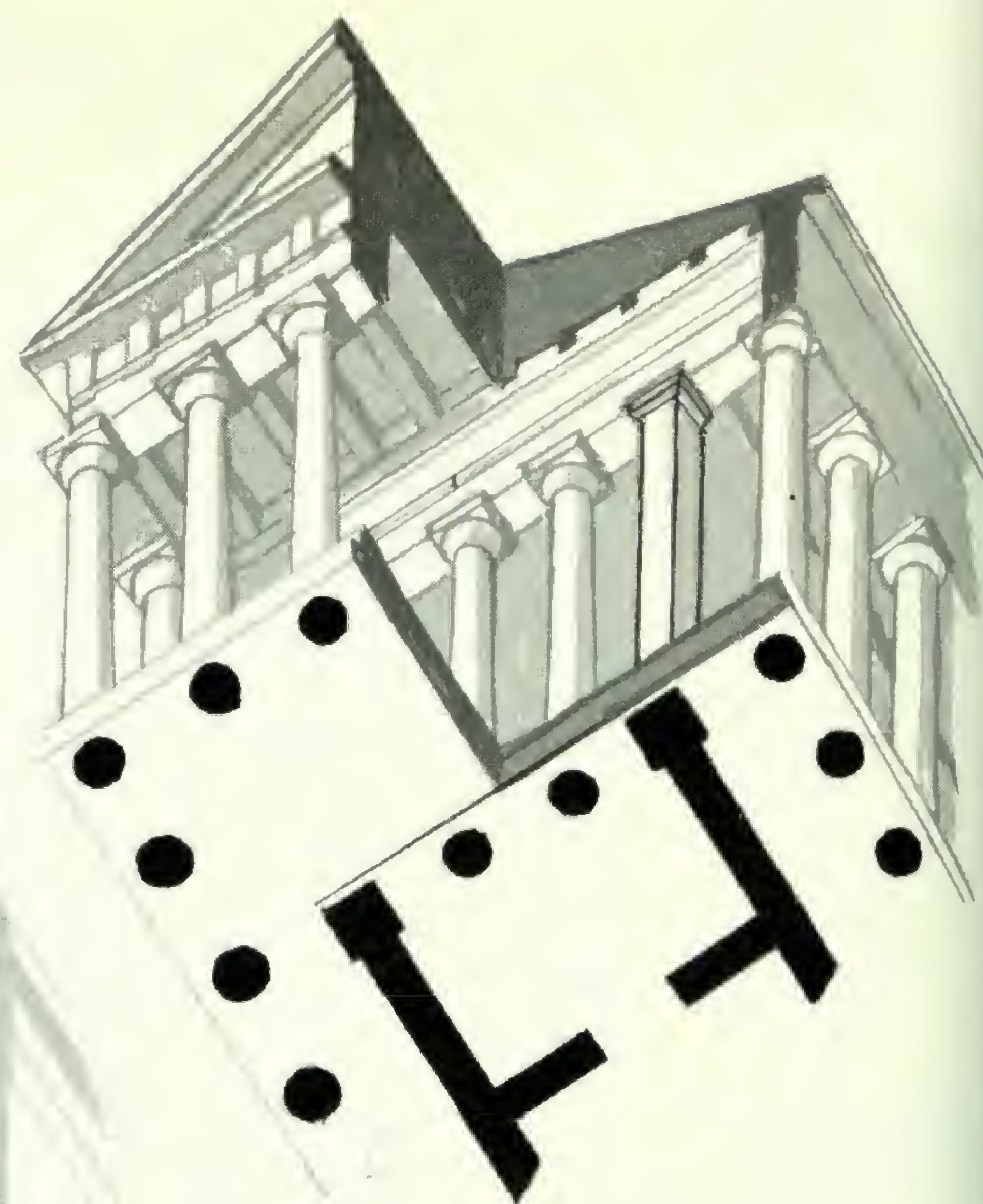
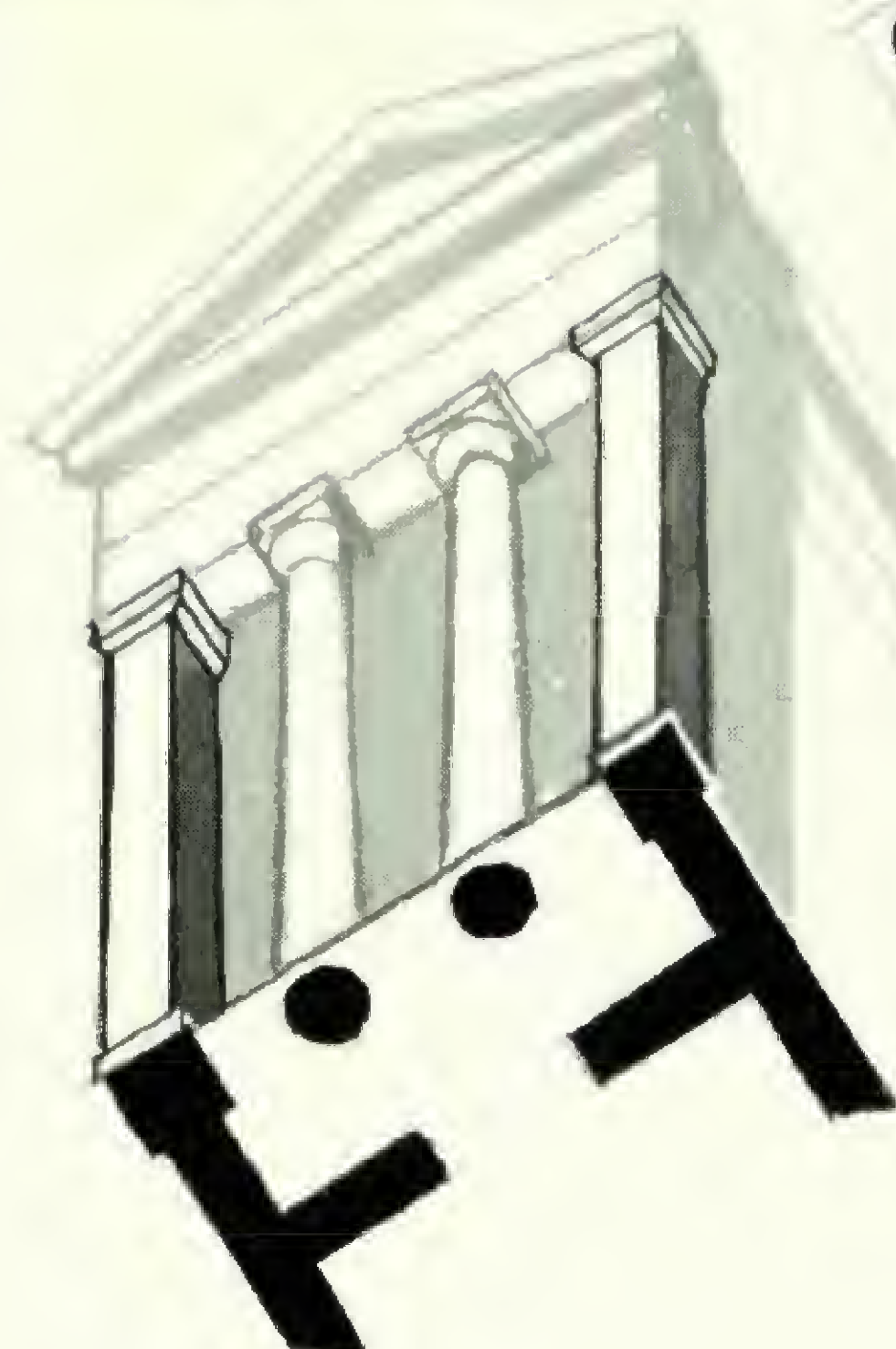
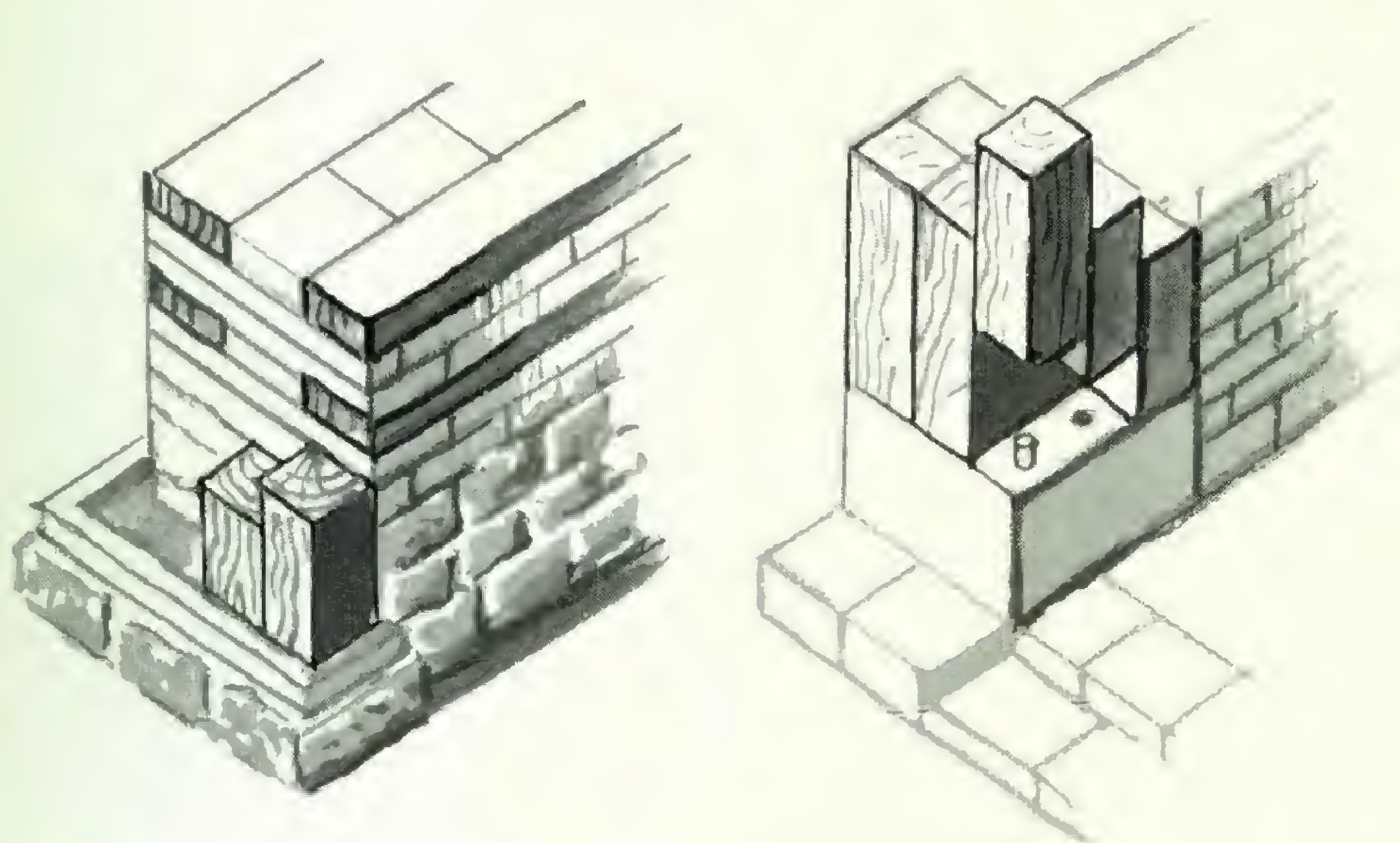
MYCENAE, The Treasury of Atreus, 1330-1300 B.C. One of some 40 beehive or tholos tombs on the Greek mainland. Built of horizontal overlapping courses of lime-stone or corbelling without centering. The door-way flanked by 2 green sandstone half-columns with a relieving triangle above



GREEK

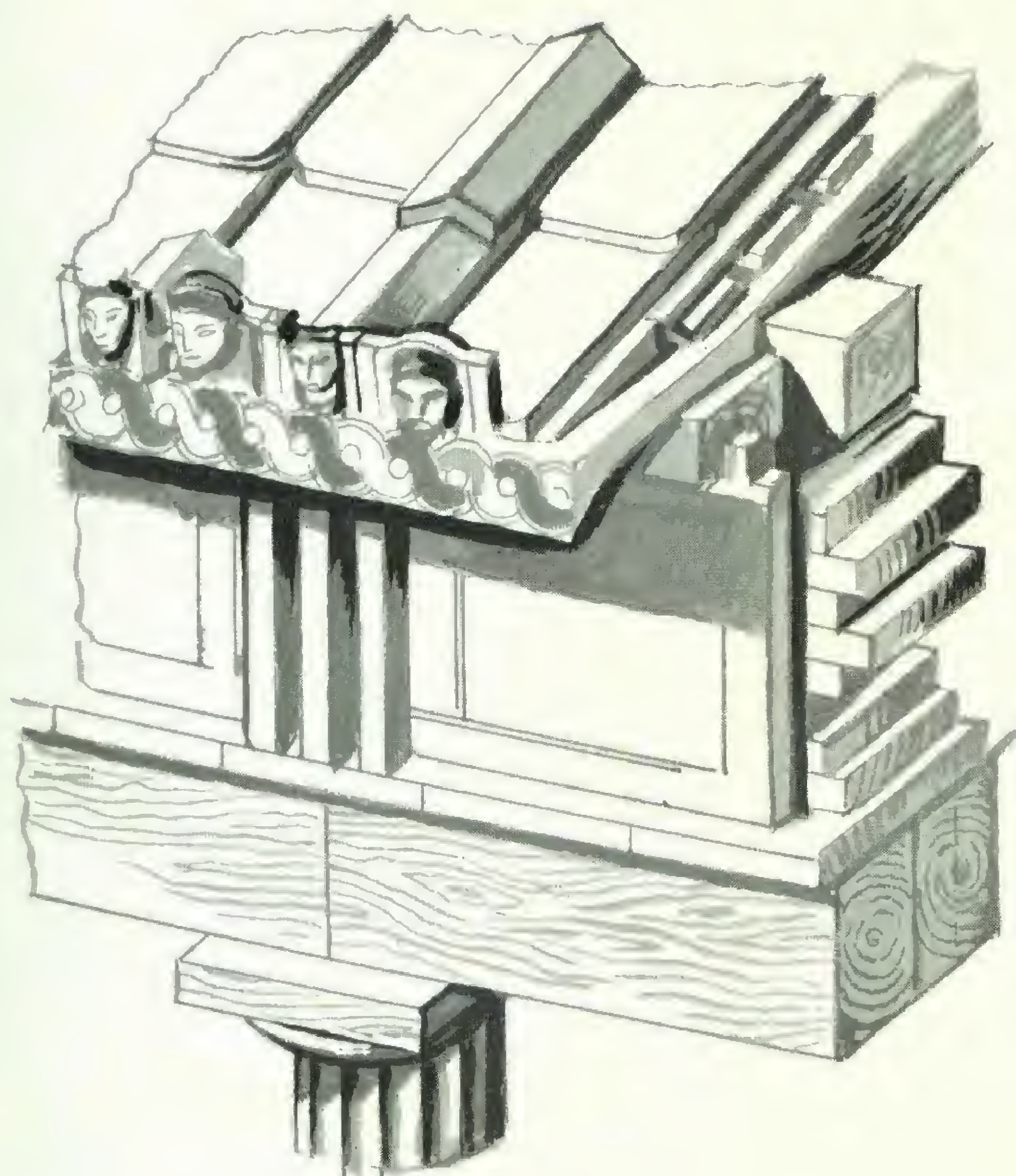


COLUMN AND BEAM

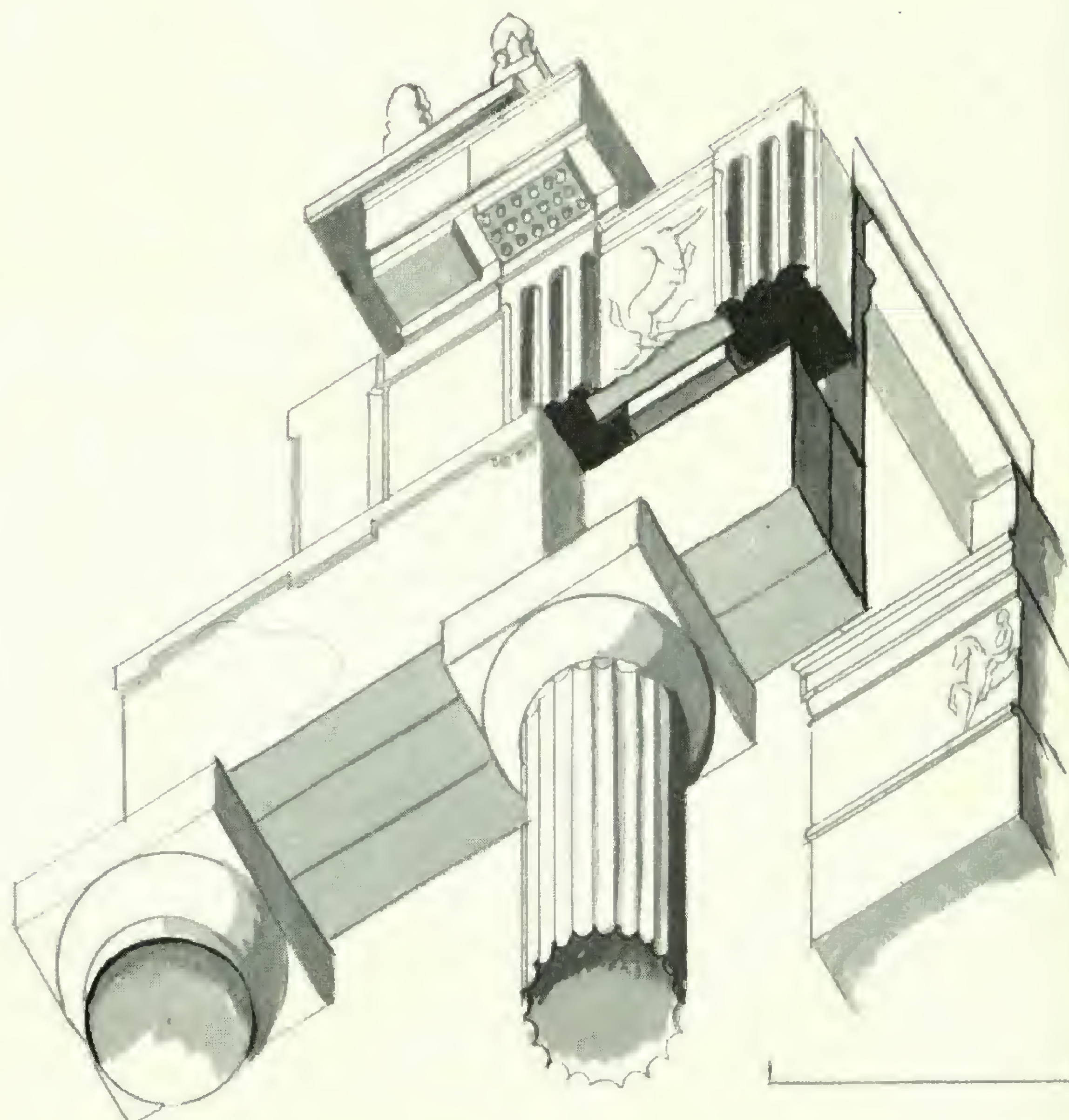


Stone beams of great span are liable to fracture, therefore columns were placed close together

TIMBER TO STONE ANTAE OR PILASTERS

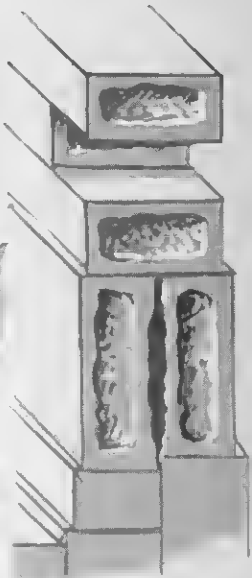
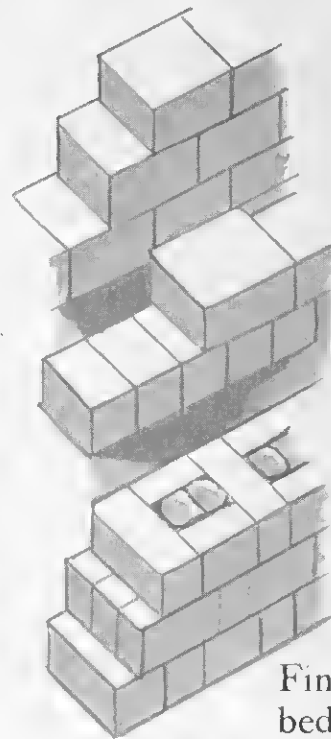
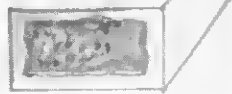
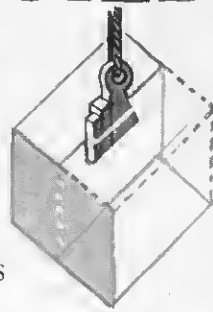
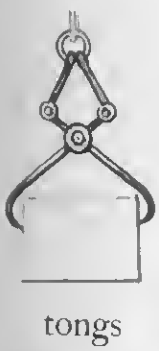


TIMBER construction, c.620 B.C.
Doric temple of Apollo, Thermum.
Wooden entablature and columns



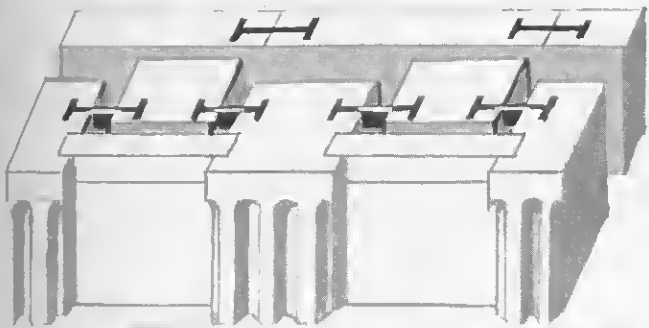
MARBLE construction, c.477-438 B.C.
The Parthenon, Athens

BUILDING METHODS

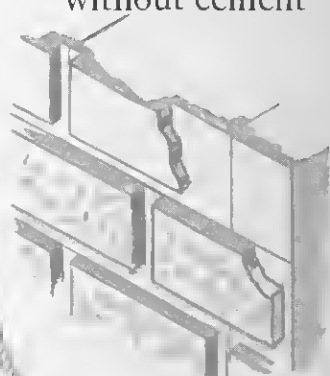


MASONRY

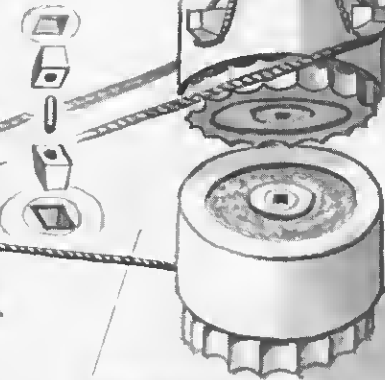
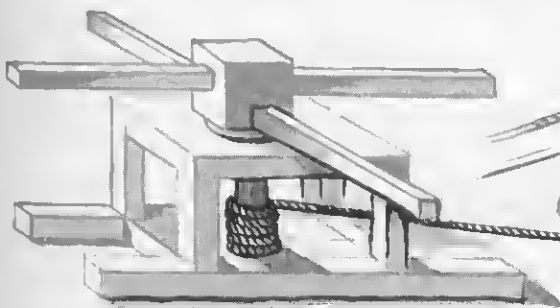
Fine squared ashlar bedded and jointed without cement



METAL CRAMPS set in molten lead



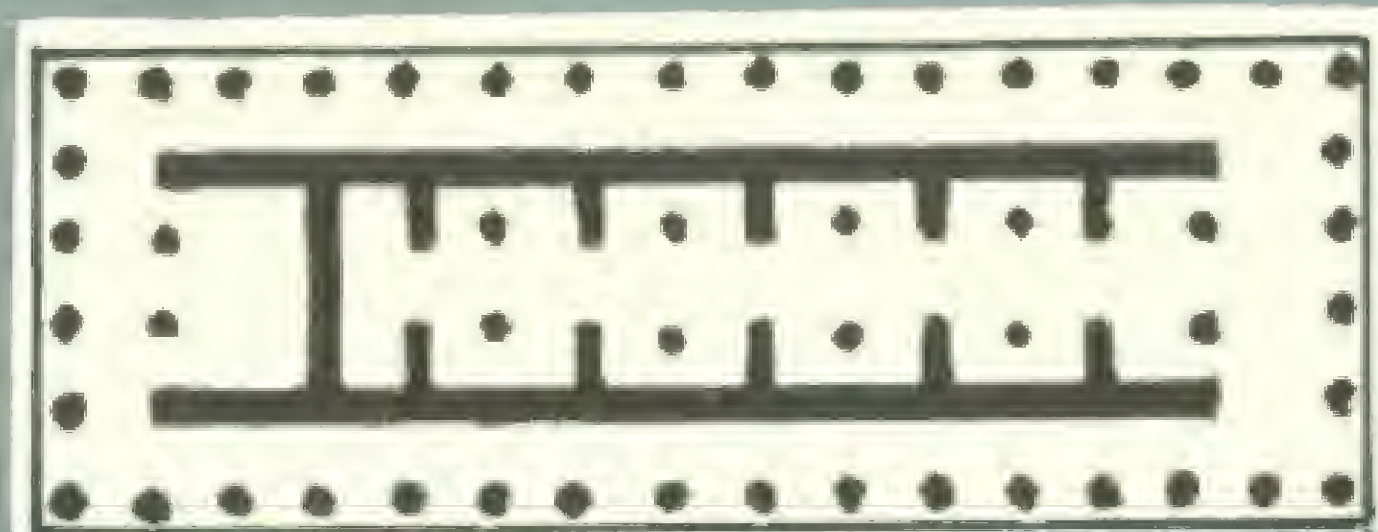
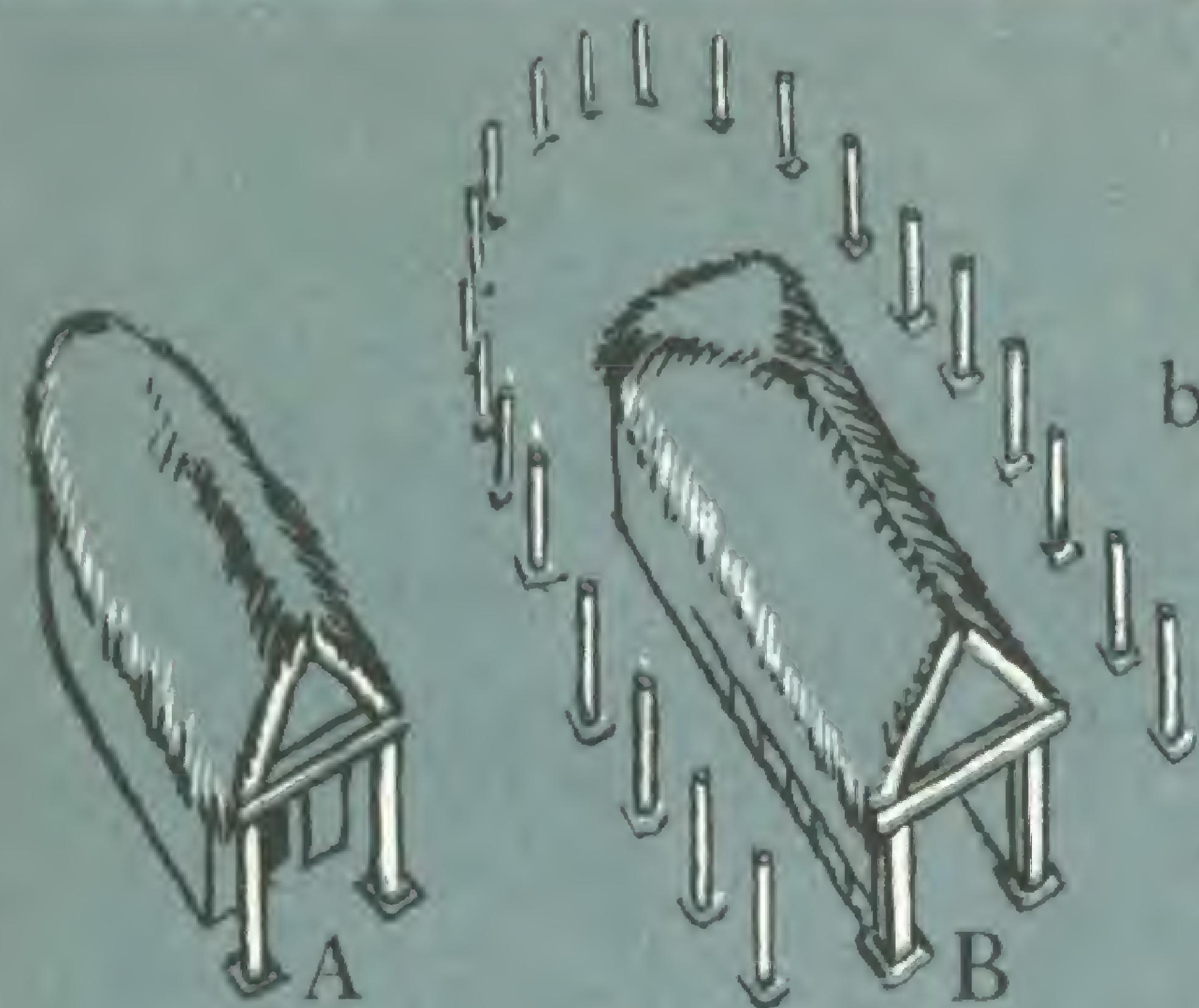
Stone left undressed to avoid damage in transport



ERECTION OF

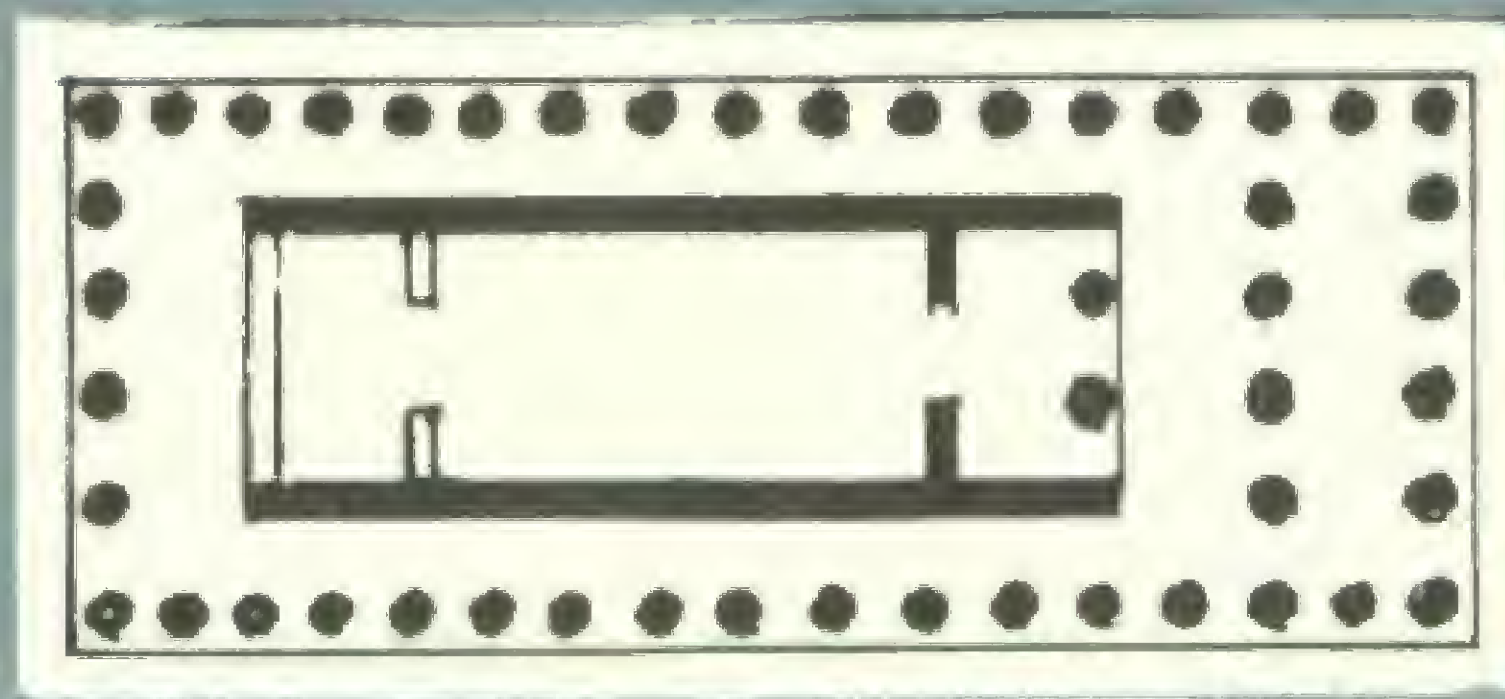
A COLUMN

GREEK



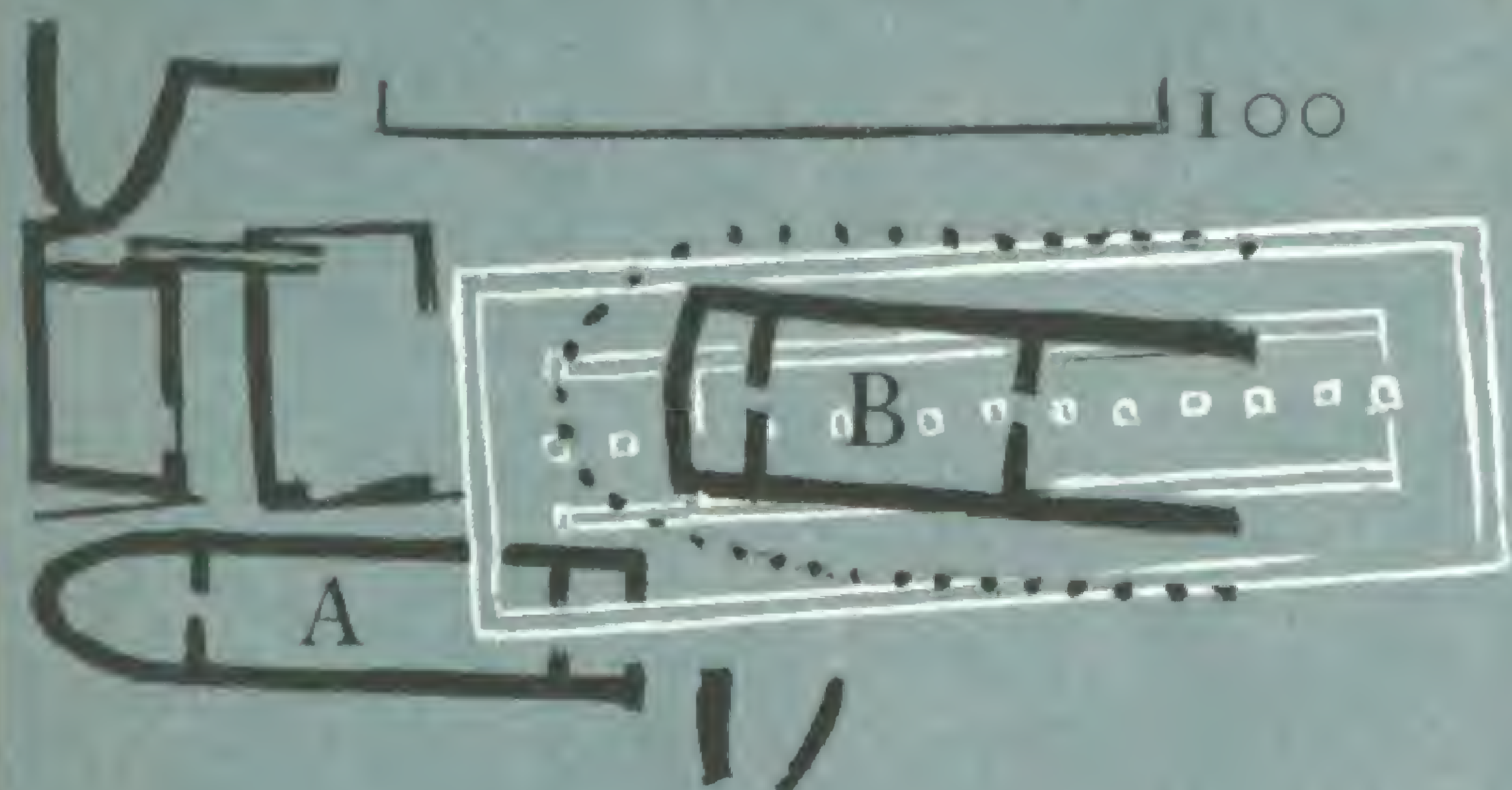
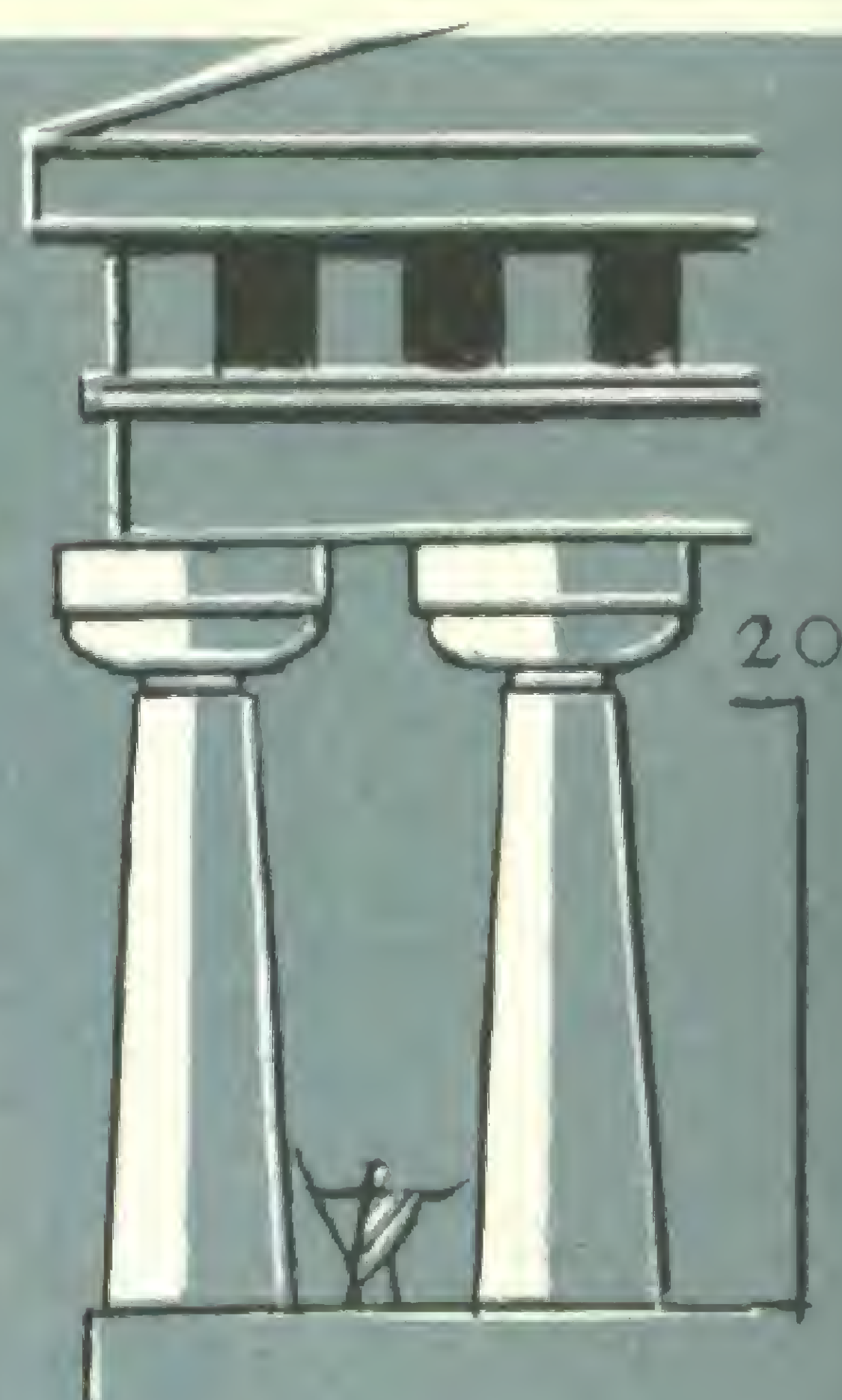
The Heraeum,
Olympia, c.649 B.C.

Walls sun-dried
brick. Stone replaced wood columns as they
decayed. Gable roof with terracotta tiles



Temple of Apollo, Syracuse, c.575 B.C.

Monolithic stone columns



Sanctuary of Thermum, Aetolia

Megaron A,

Megaron B,

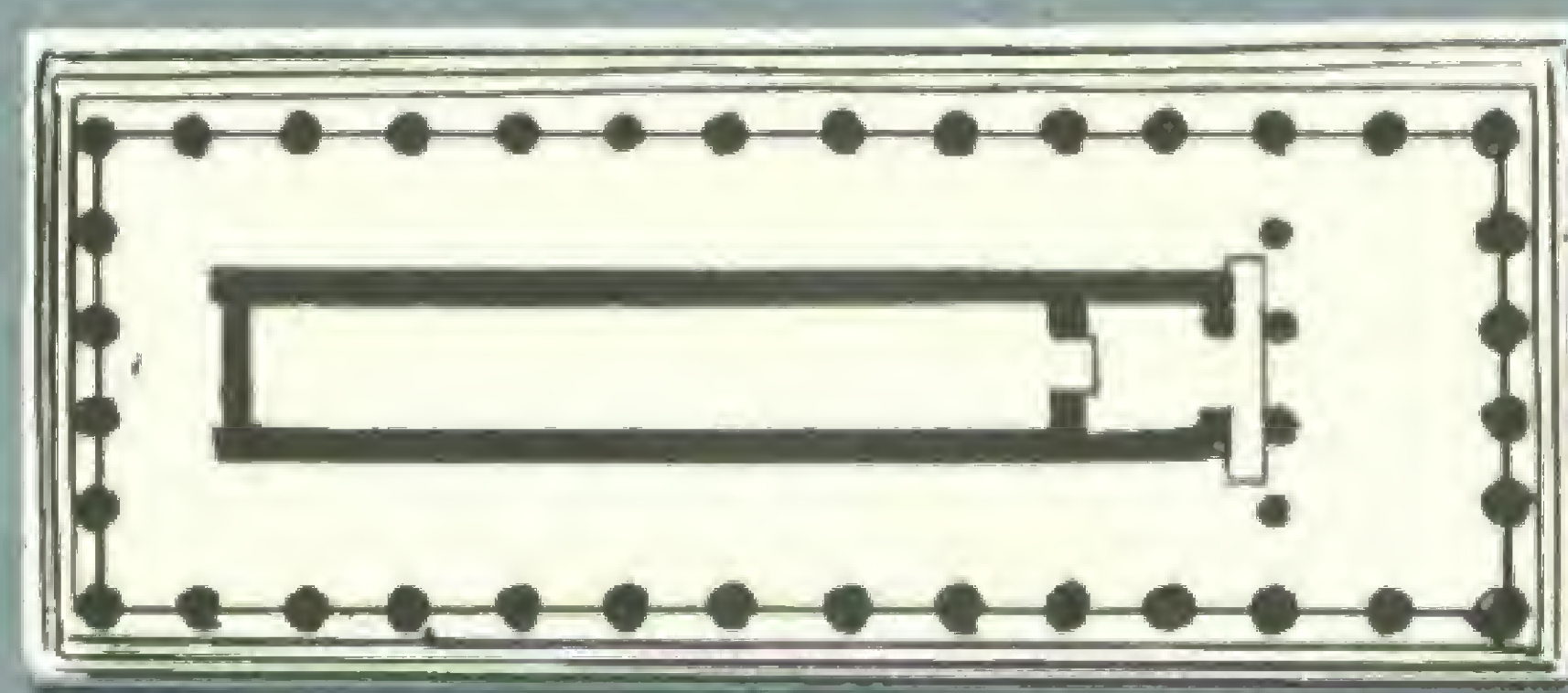
c.2000-1500 B.C.

c.1000-800 B.C.

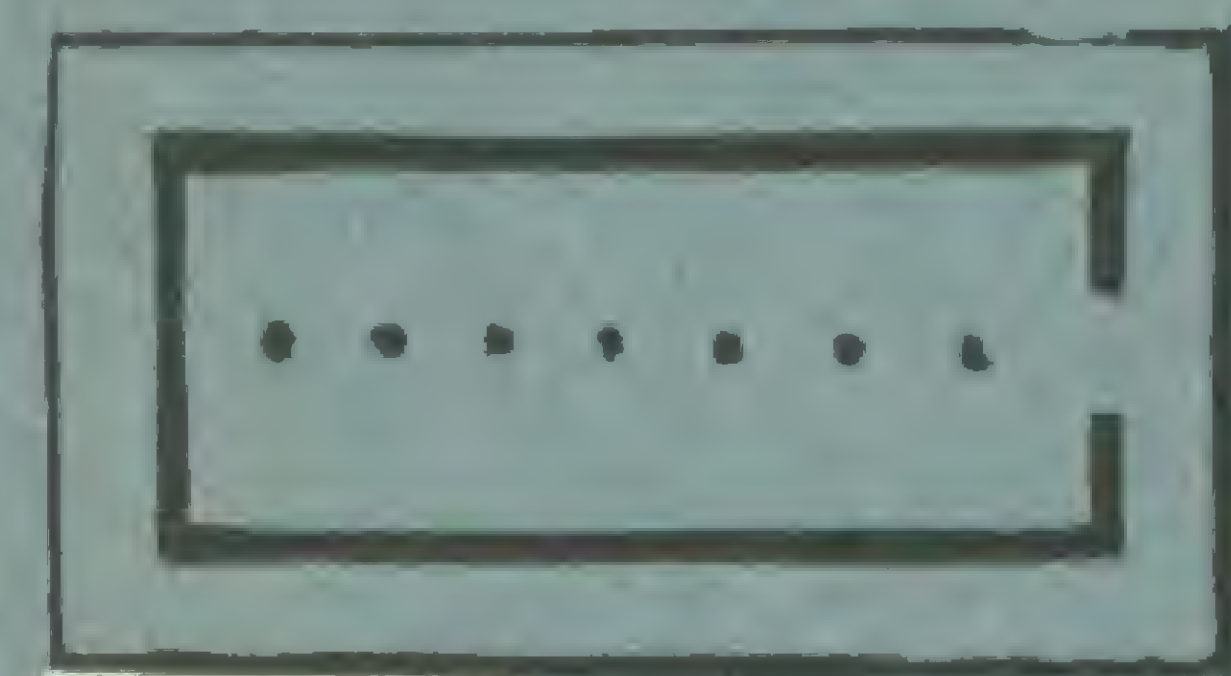
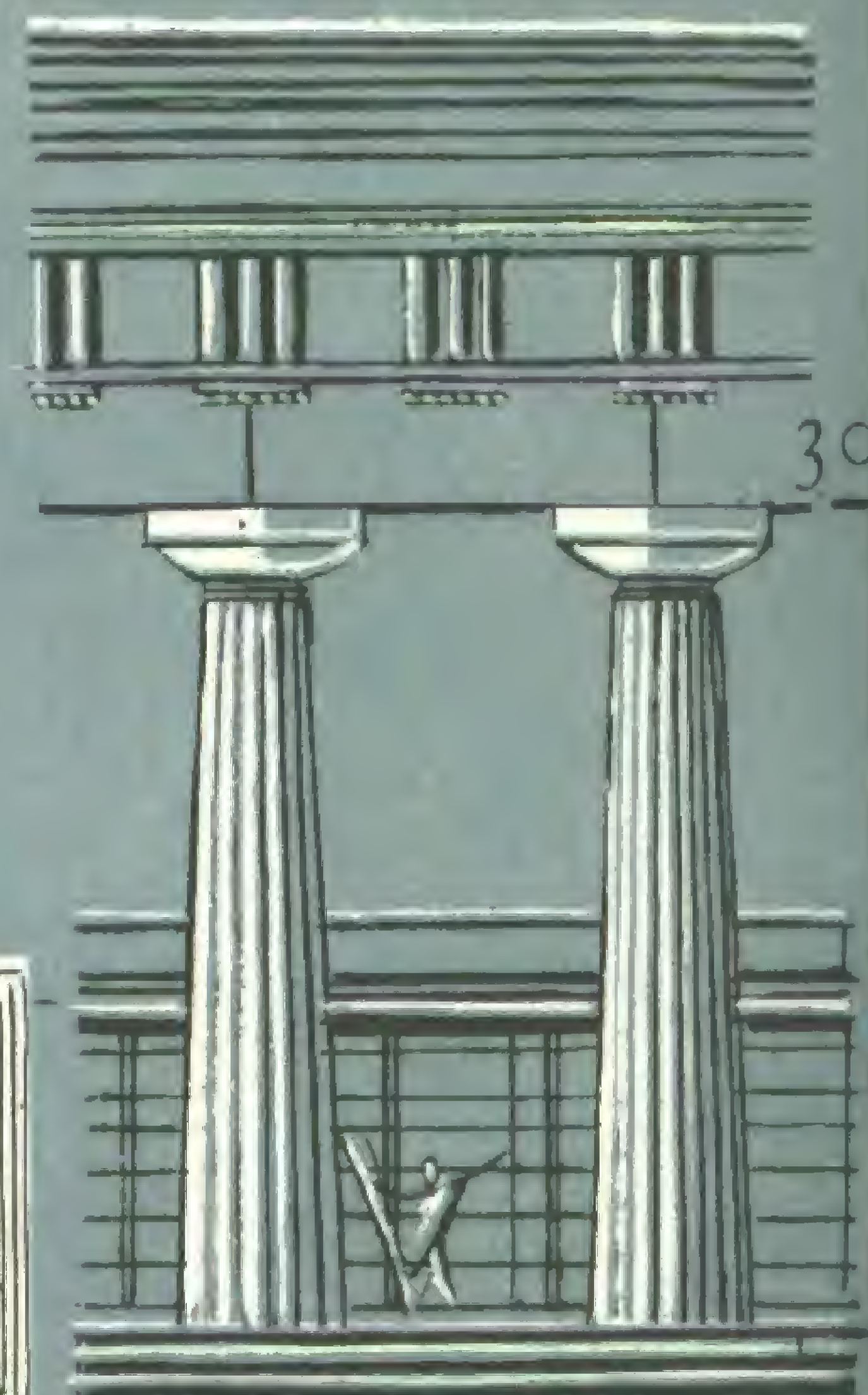
Small stones
carry walls of
wood and clay,
roof thatched
with reeds

House or Temple.
18 posts formed
the first known
Greek peripteral
temple scheme

The Temple of Apollo,
c.600 B.C.,
built over Megaron B.
Columns and entablature
of wood

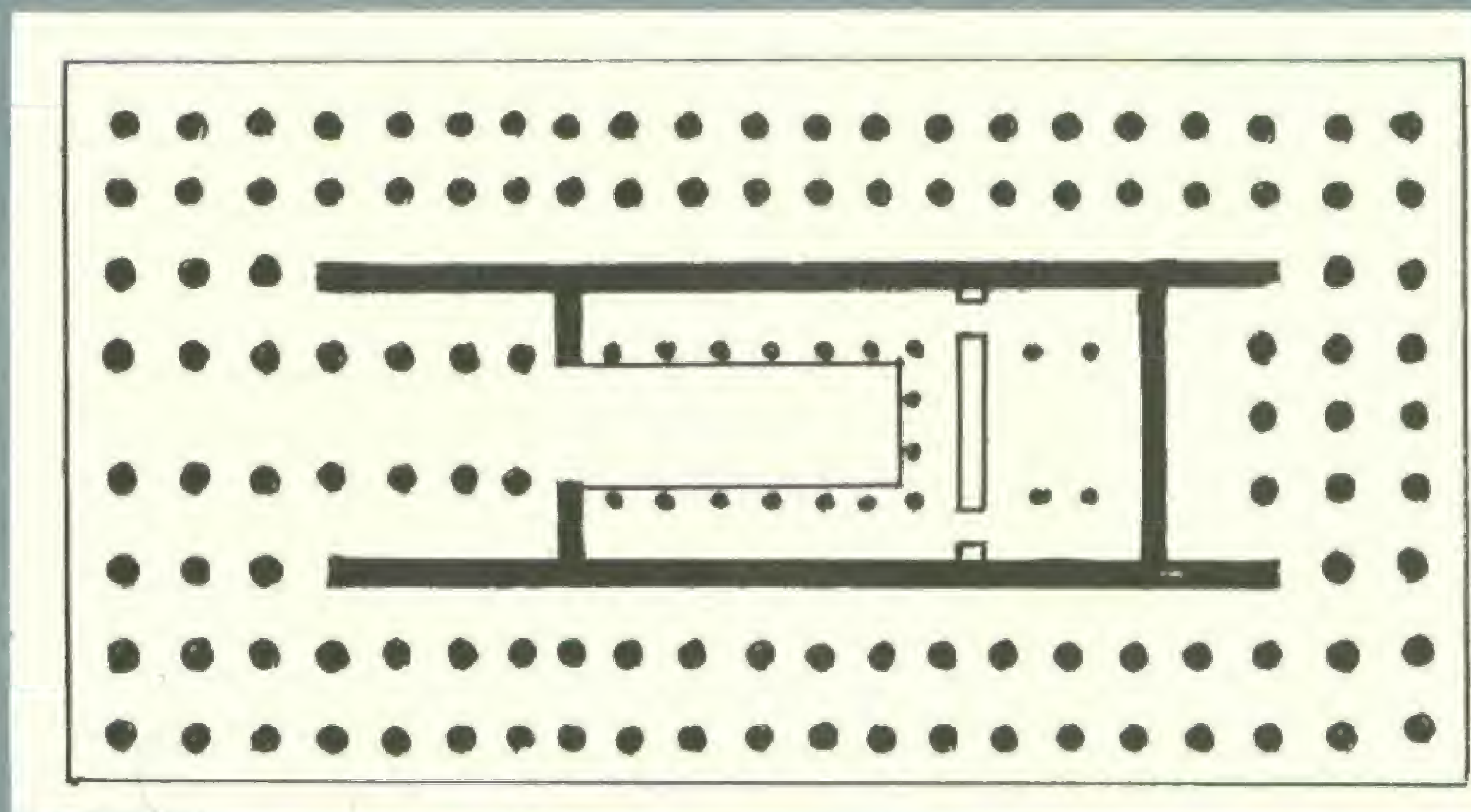


Temple F, Selinus, c.560 B.C.
Stone screens join the columns

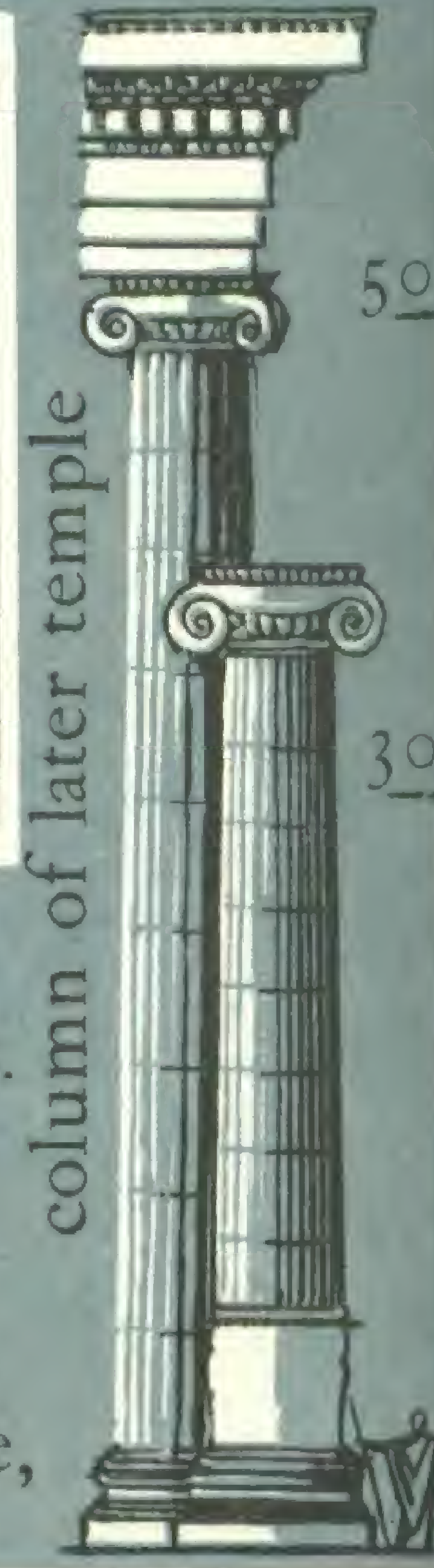


Temple of
Neandria, Asia Minor,
c.7th century B.C.

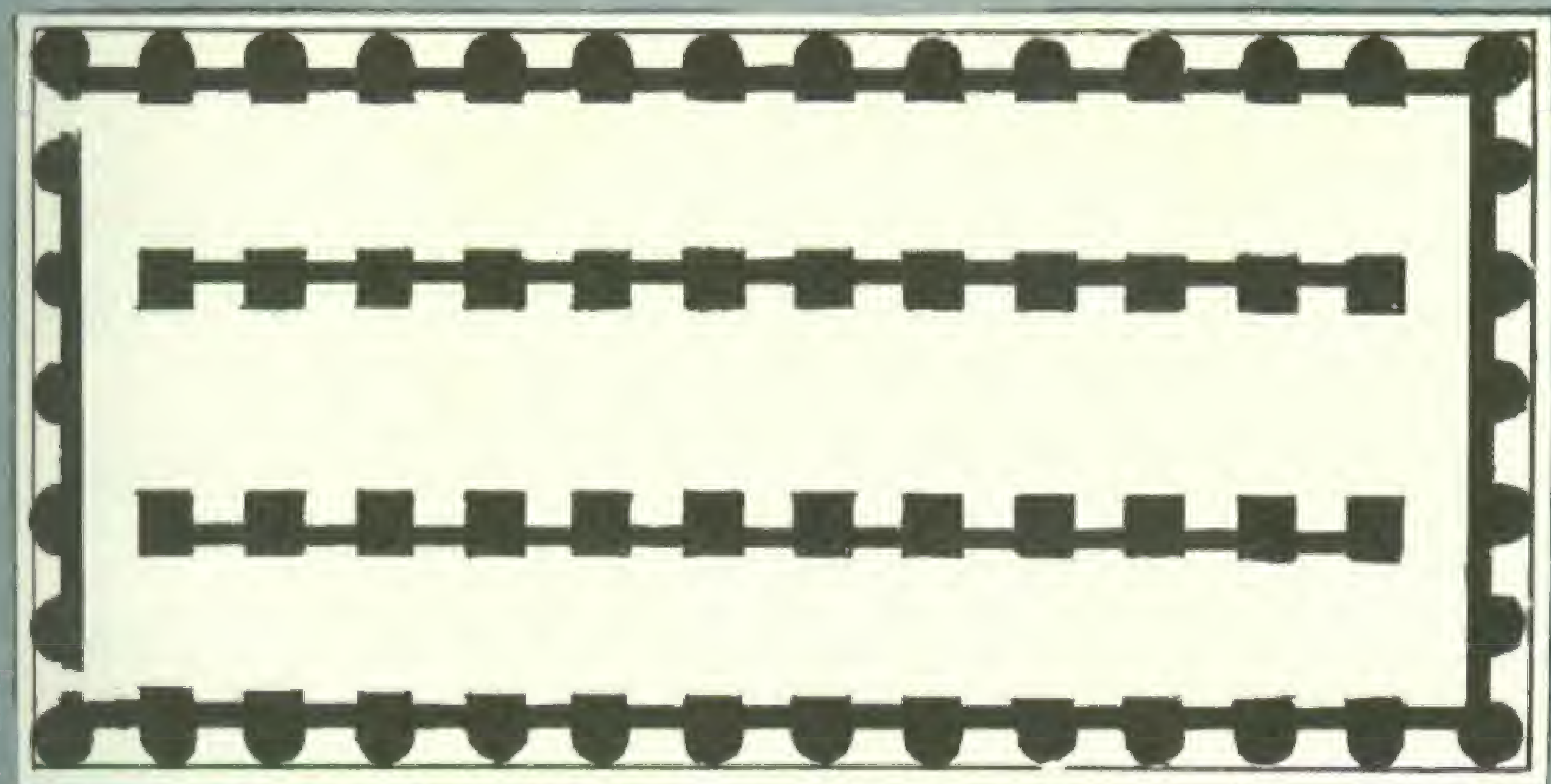
Built of sandstone, roof gabled
with tiles, 7 stone columns
have 'Aeolic' capitals,
i.e. Asiatic-Ionic motifs.



Archaic Temple of Artemis, Ephesus,
c.560 B.C. Burnt down and rebuilt, 356 B.C.
Designed by Chersiphron of Cnossus and
his son Metagenes who wrote a work on
the temple, now lost, cited by Vitruvius.
Appearance conjectural, columns of marble,
walls of limestone faced with marble

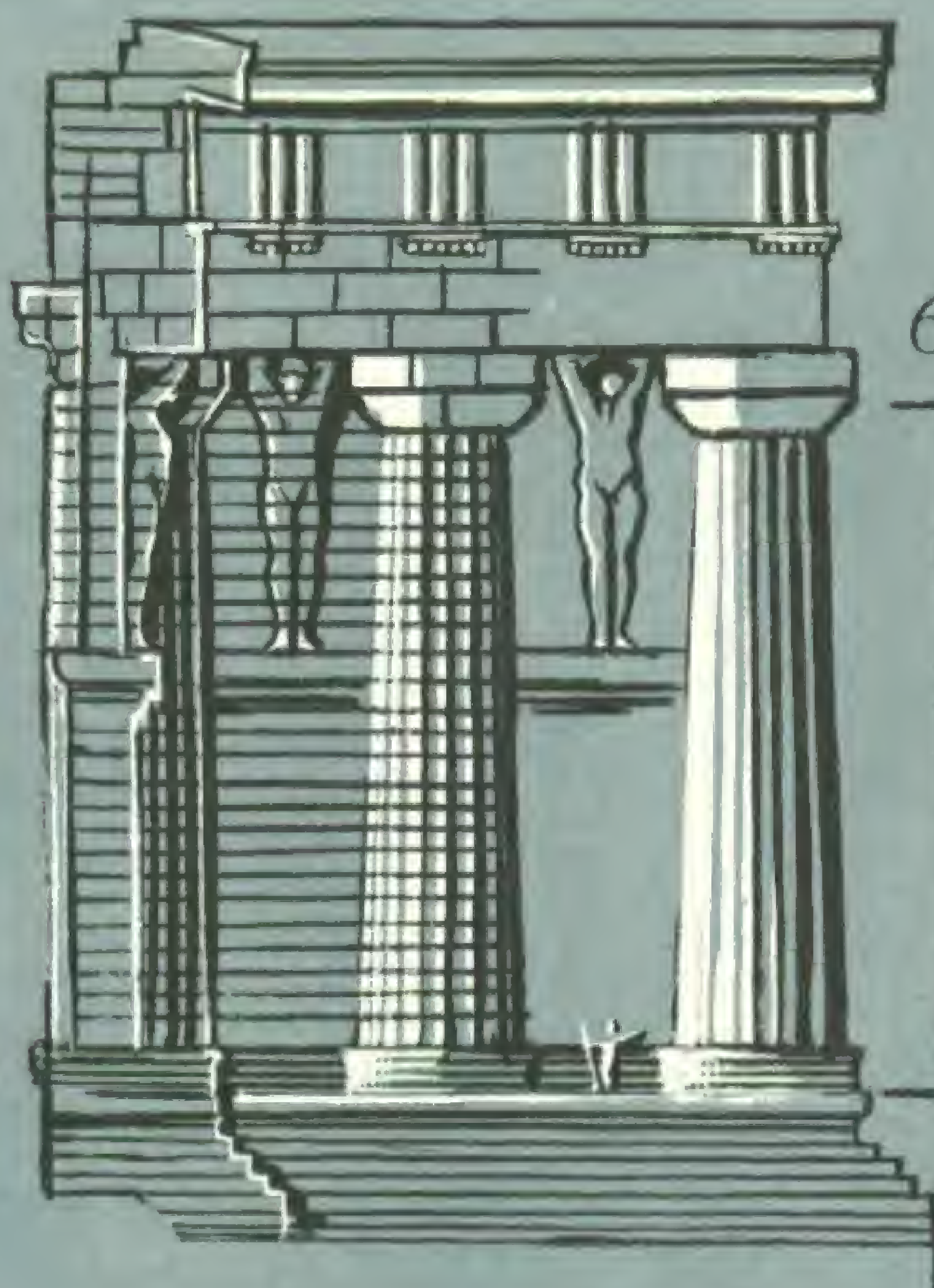


PLANS, DORIC & IONIC TEMPLES



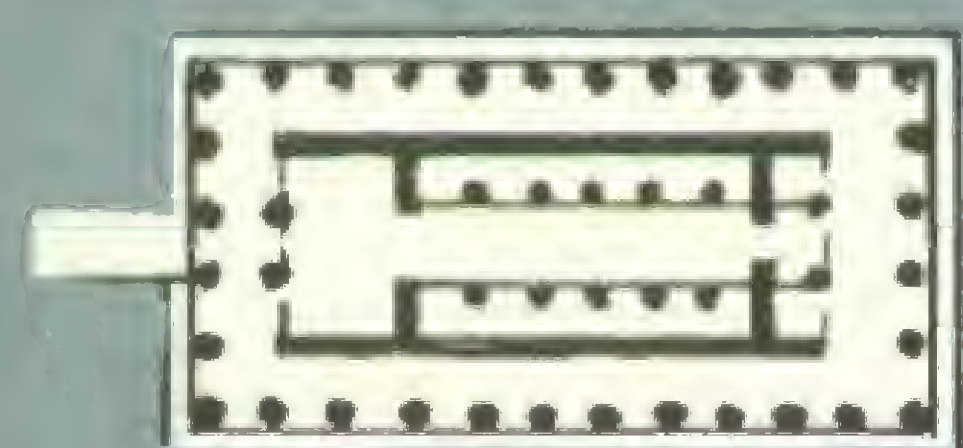
Temple of Zeus Olympius, Agrigento, c.480 B.C.

Built of coarse stone faced with marble dust cement; position of figures conjectural

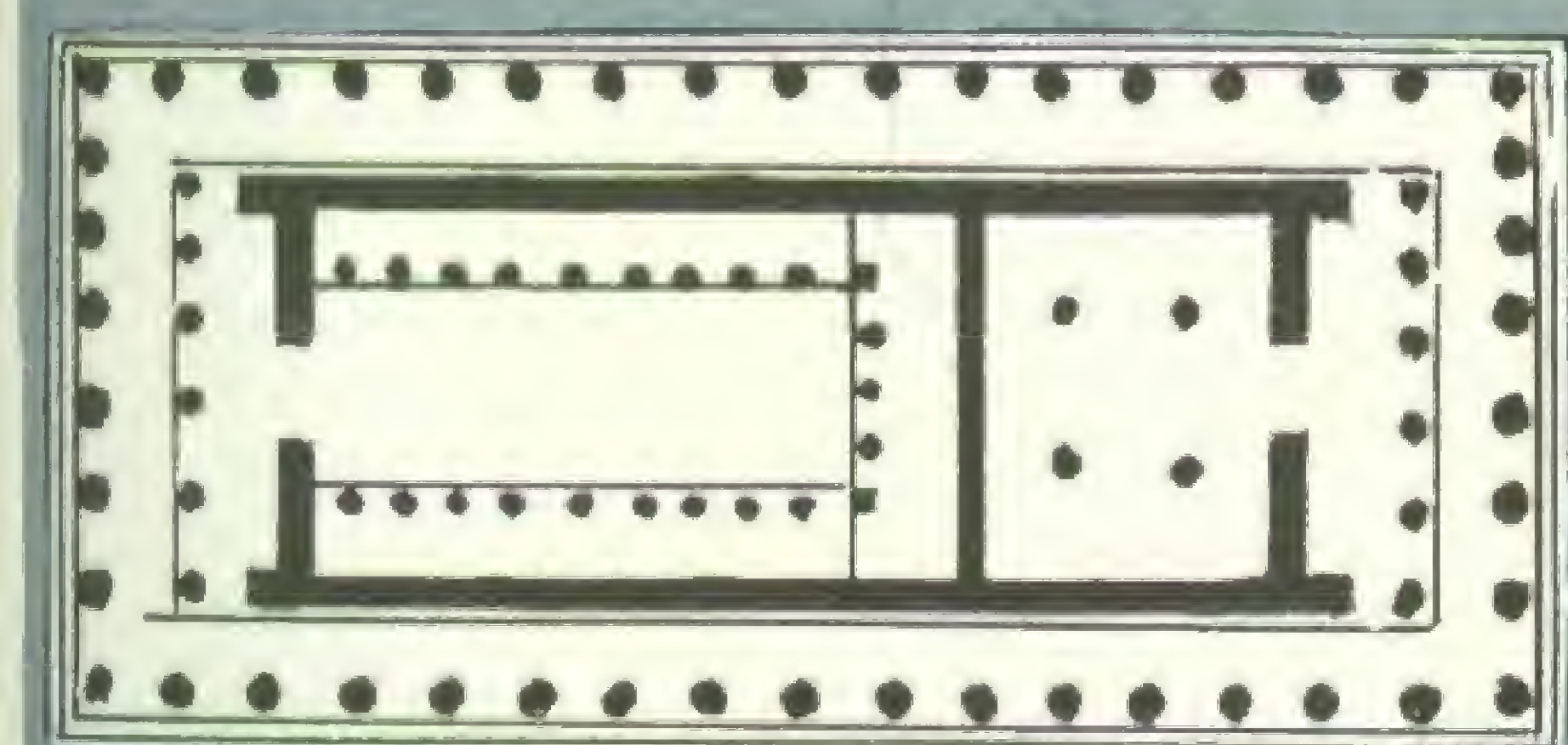


Plans drawn in black to the same scale

100

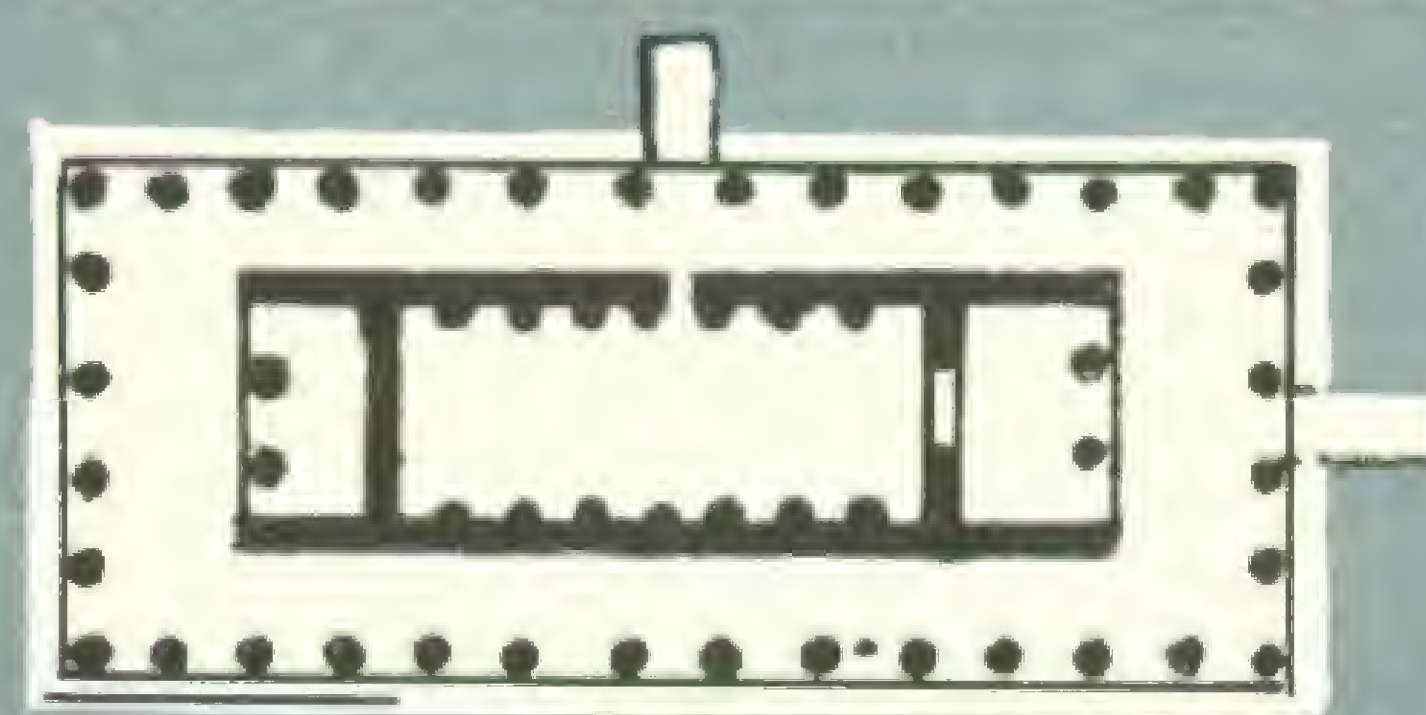
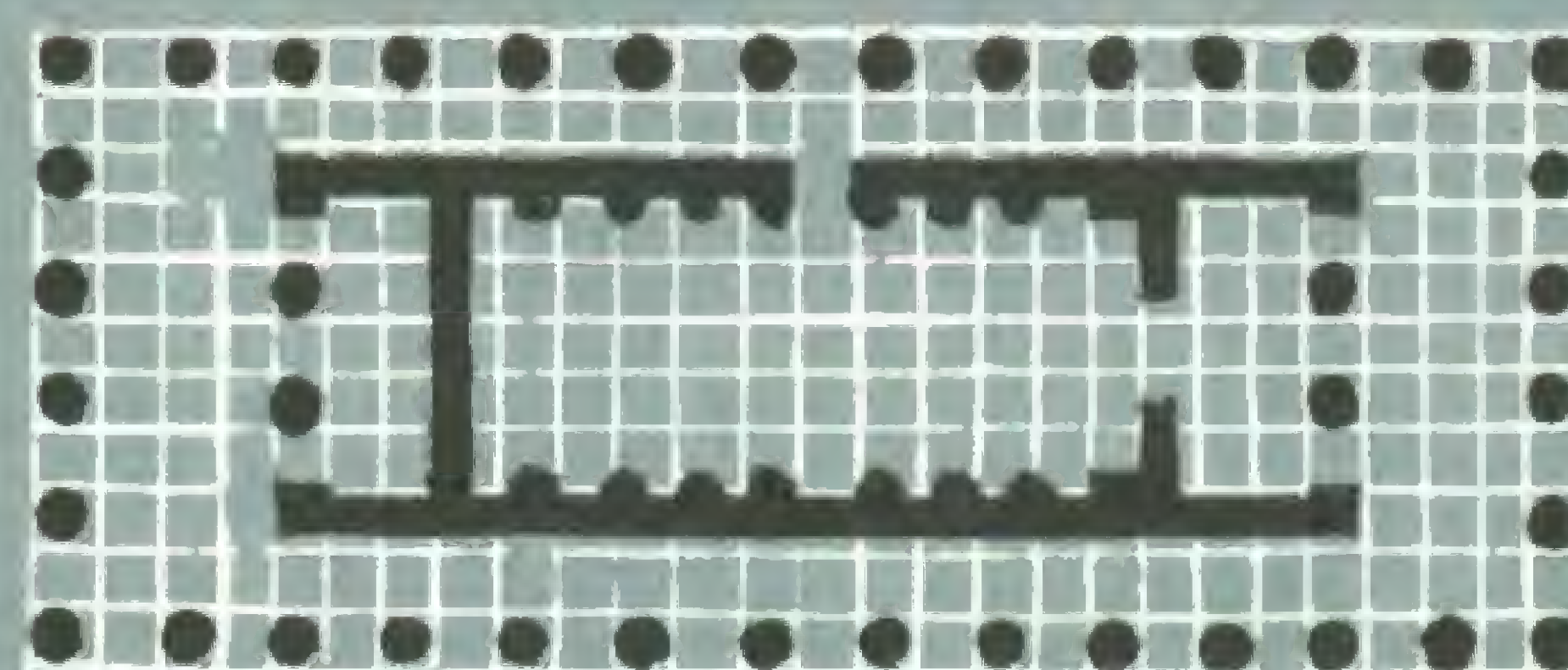


Temple of Aphaia, Aegina, c.490 B.C.



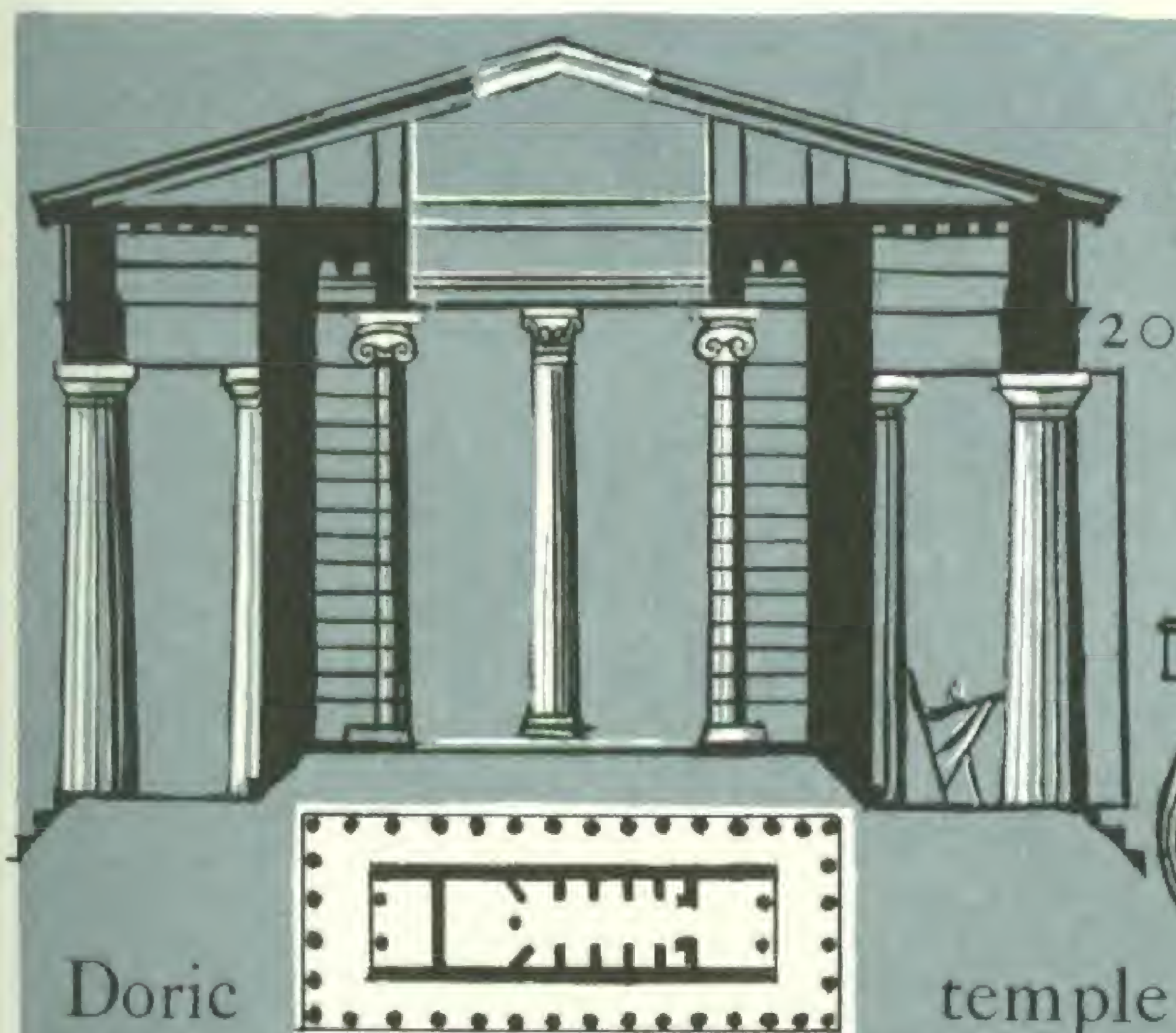
The Parthenon, Athens, 447-432 B.C.

Ictinus and Callicrates architects, Pheidias master sculptor; built of white marble



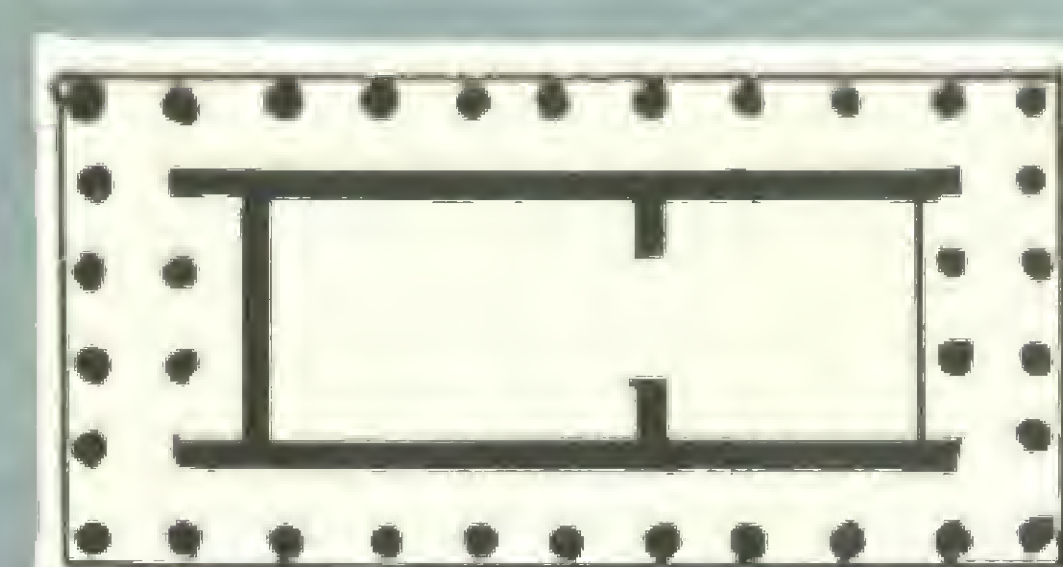
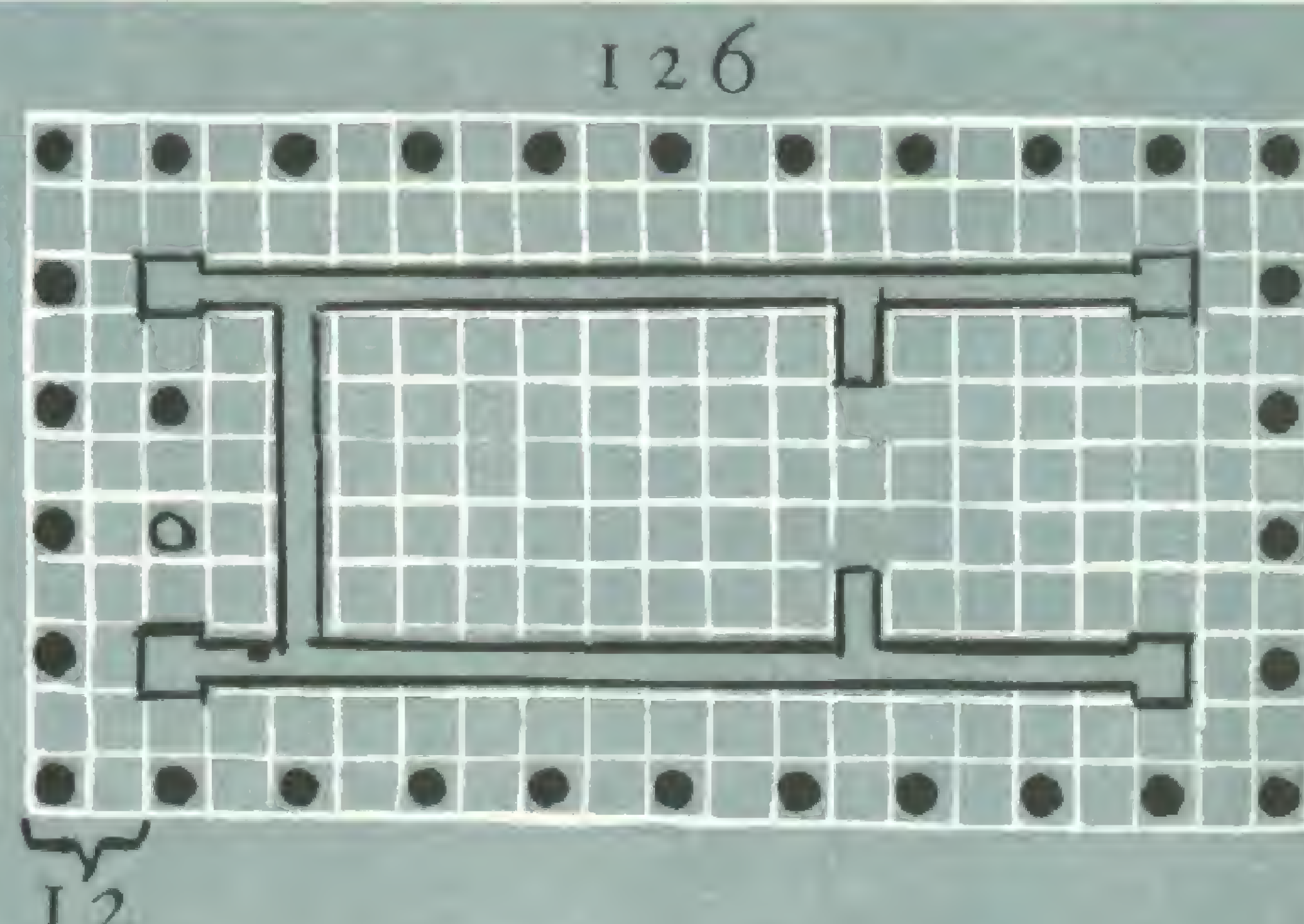
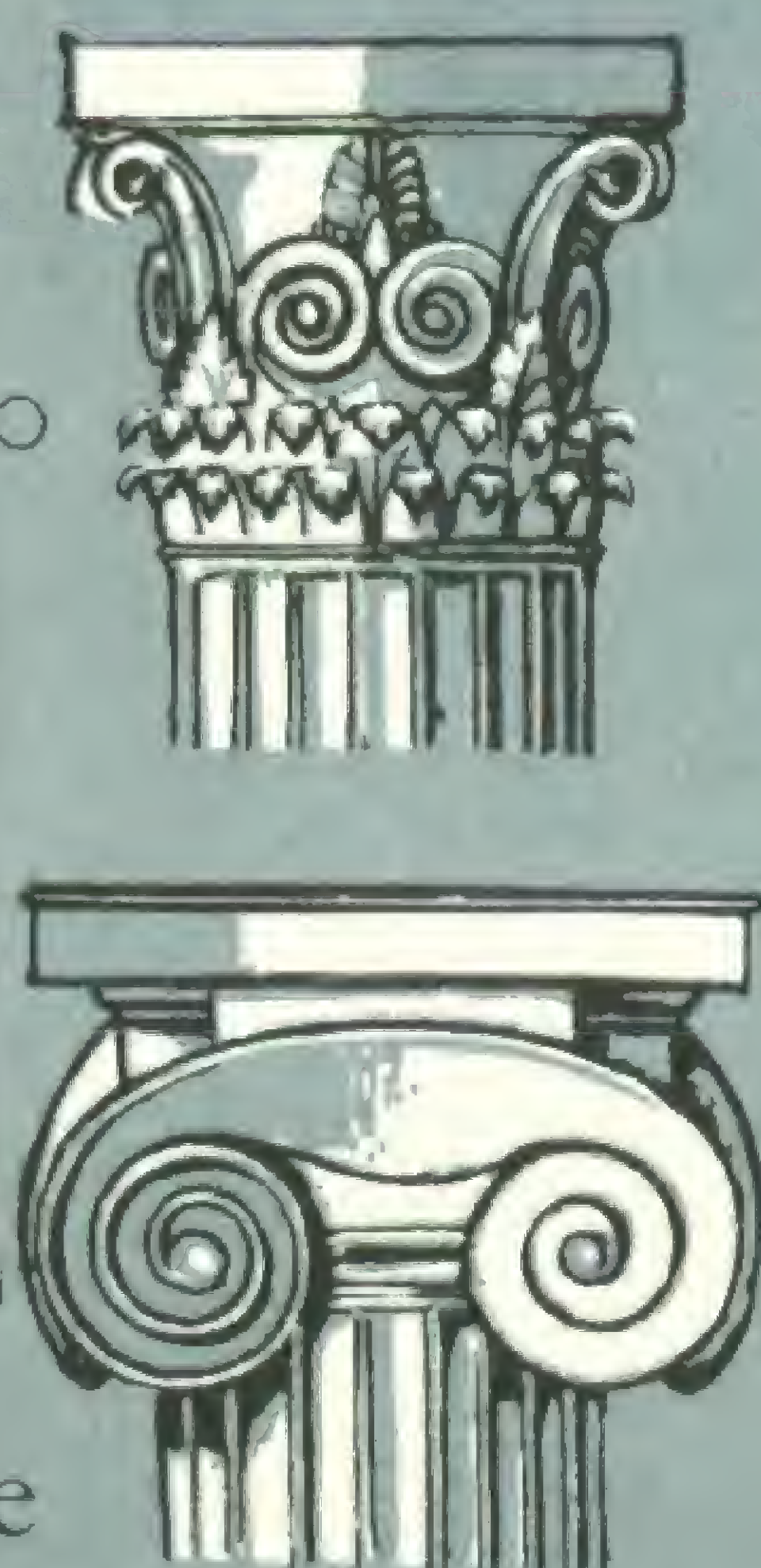
The Doric Temple of Athena Alea, Tegea, c.353 B.C.

Designed by the sculptor Scopas, the interior had 14 Corinthian engaged columns



Doric temple of Apollo Epicurius, Bassae, c.430 B.C.

By Ictinus, architect of the Parthenon, Athens. The Corinthian order used for the first time. Built of fine-grained, brittle grey limestone; details in marble, roof of thin marble slabs.



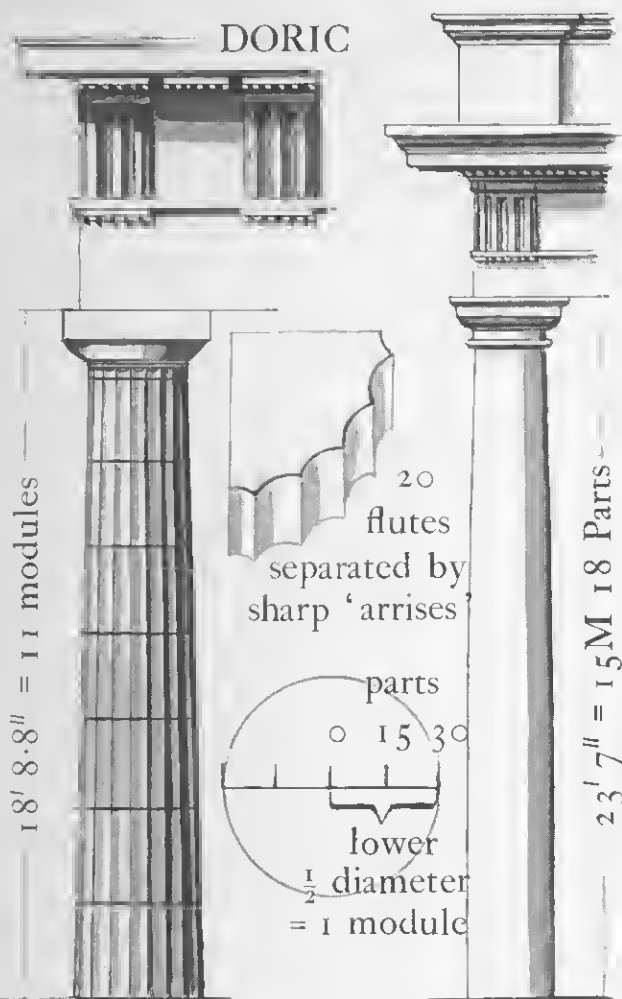
Ionic temple of Athena Polias, Priene, c.334 B.C.

By Pythios, architect and sculptor of the Mausoleum, Halicarnassus, who wrote a book on the temple, since lost. All the measurements are in multiples of the Ionic foot, i.e. 11.587 inches.



GREEK & ROMAN

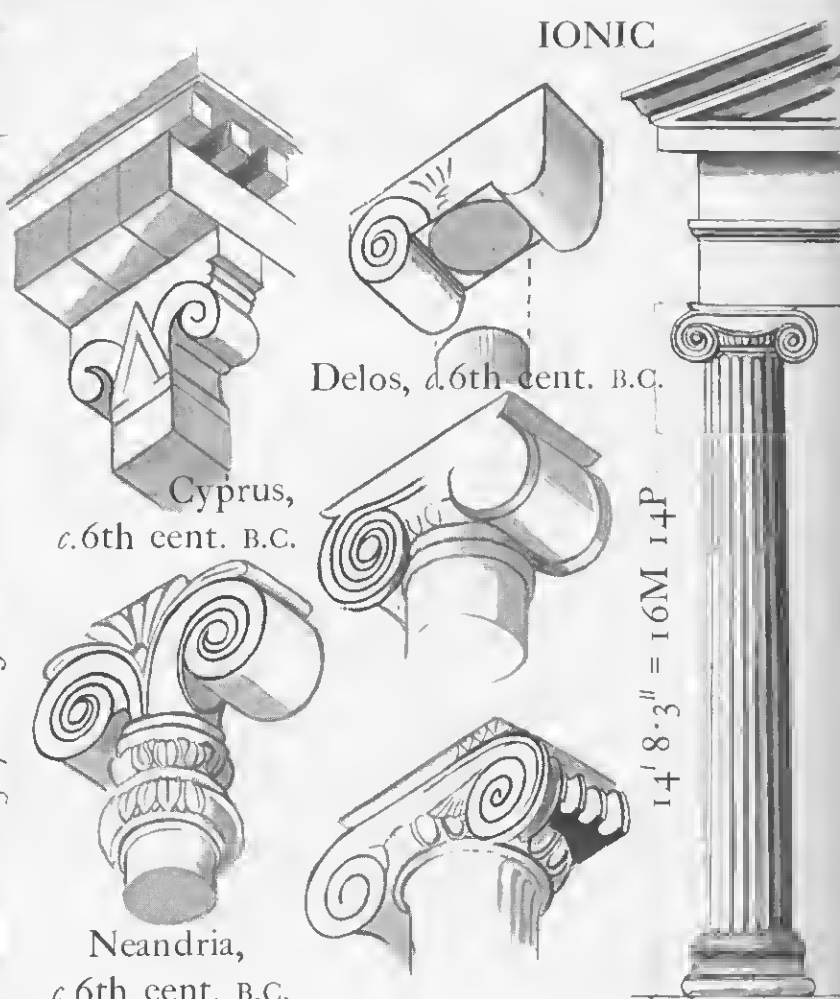
DORIC



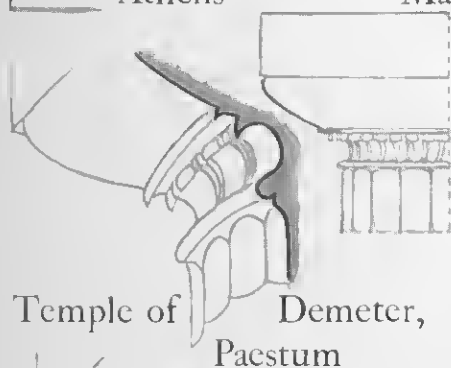
Greek
The Theseion,
Athens

Roman
Theatre of
Marcellus, Rome

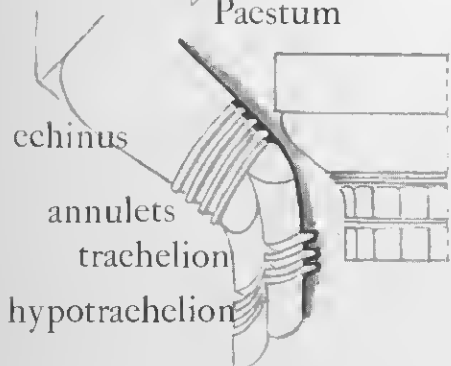
IONIC



Greek
Temple on the
Ilissus, Athens



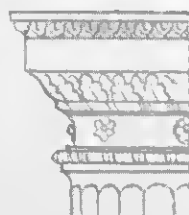
Temple of
Demeter,
Paestum



Temple of Aphaia, Aegina



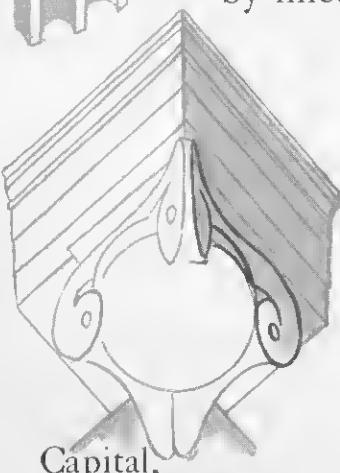
Theatre of
Marcellus,
Rome



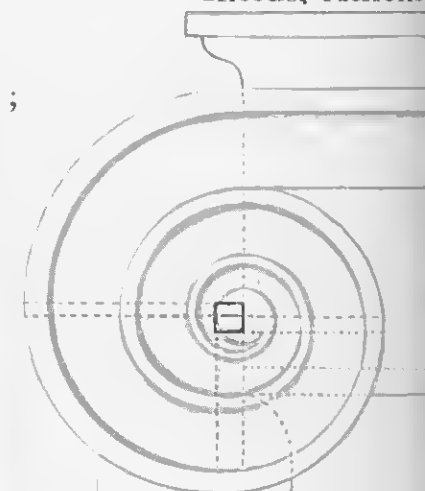
Thermae of
Diocletian,
Rome



Ionic and
Corinthian;
24 flutes
separated
by fillets



Capital,
angle column



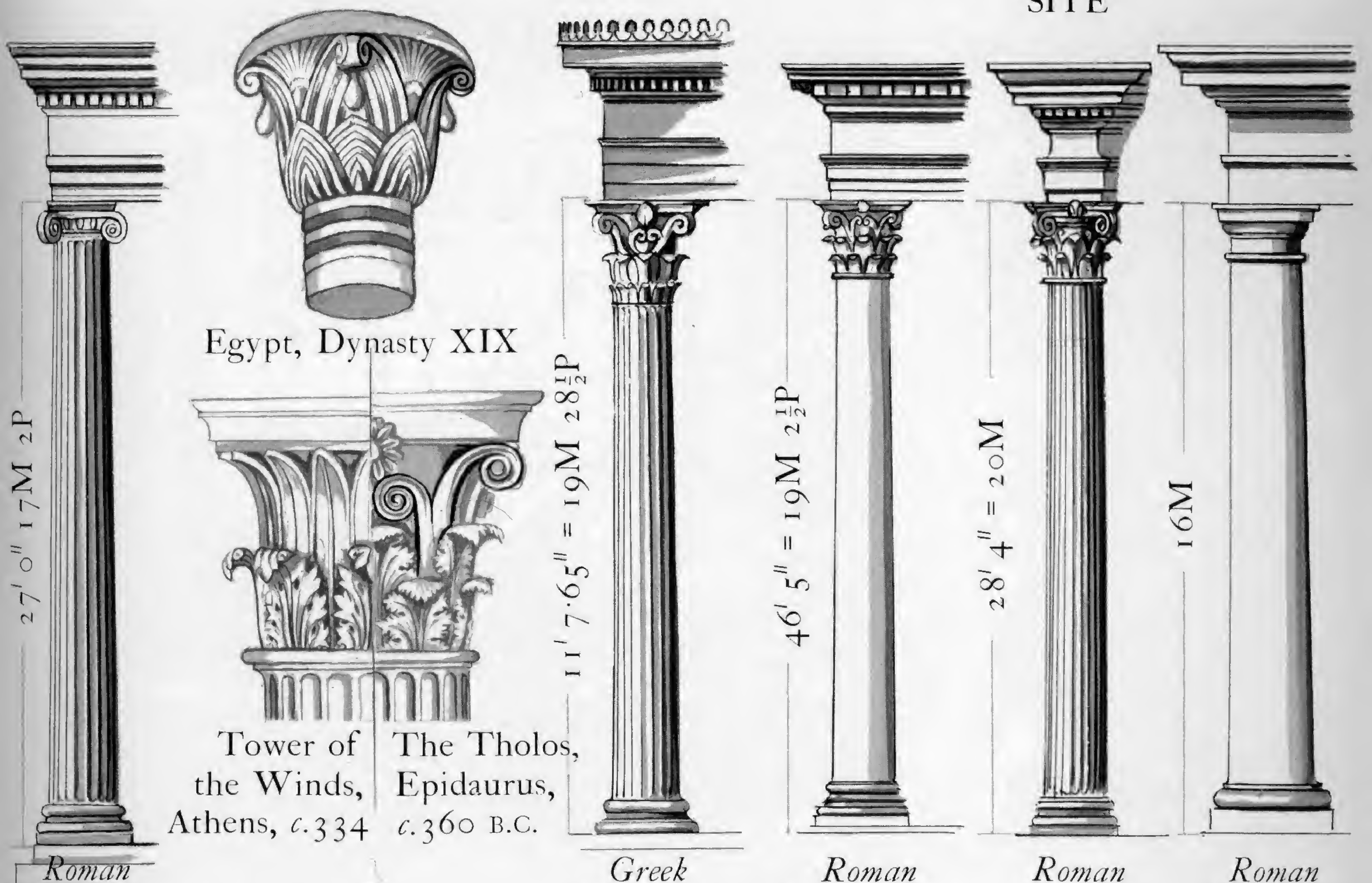
A method
of setting out
a volute

THE FIVE ORDERS

CORINTHIAN

COMPO-
SITE

TUSCAN



Egypt, Dynasty XIX

Tower of
the Winds,
Athens, c. 334

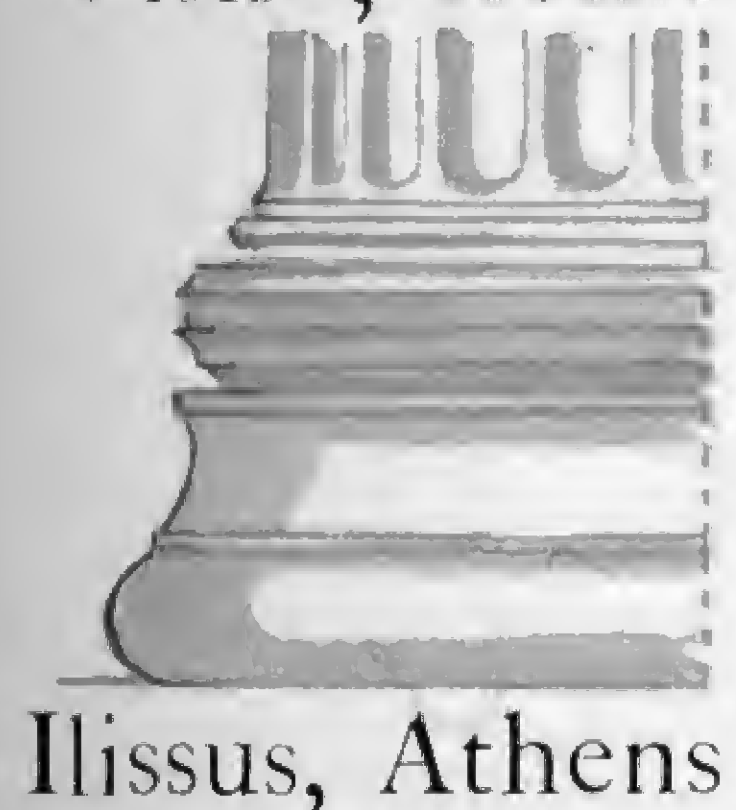
The Tholos,
Epidauros,
c. 360 B.C.

Greek
Choragic
Monument, Athens

Roman
The Pantheon,
Rome

Roman
Arch of
Severus, Rome

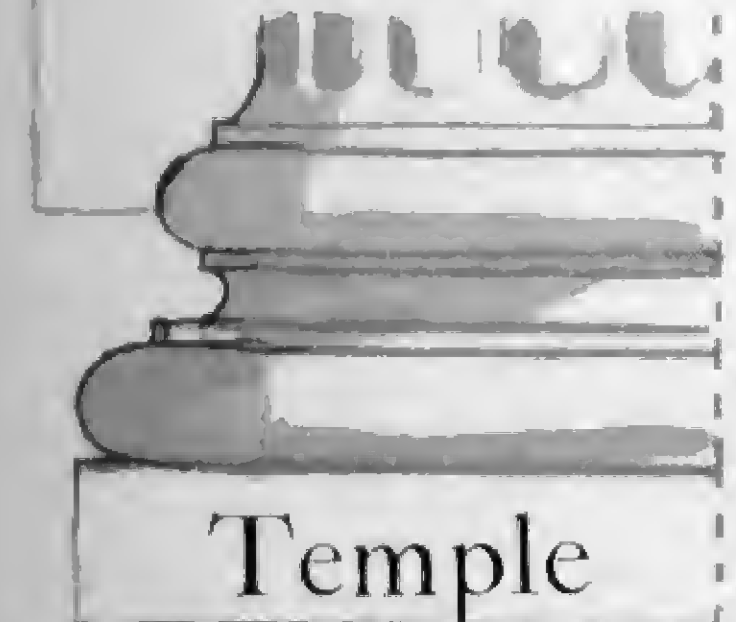
Roman
Vitruvius
(IV, 7)



Ilissus, Athens



Erechtheum,
Athens



Temple
Fortuna Virilis,
Rome



The Olympieum,
Athens, c. 174 B.C.
Capitals taken
to Rome, 86 B.C.



Temple of
Castor and Pollux,
Rome, A.D. 16

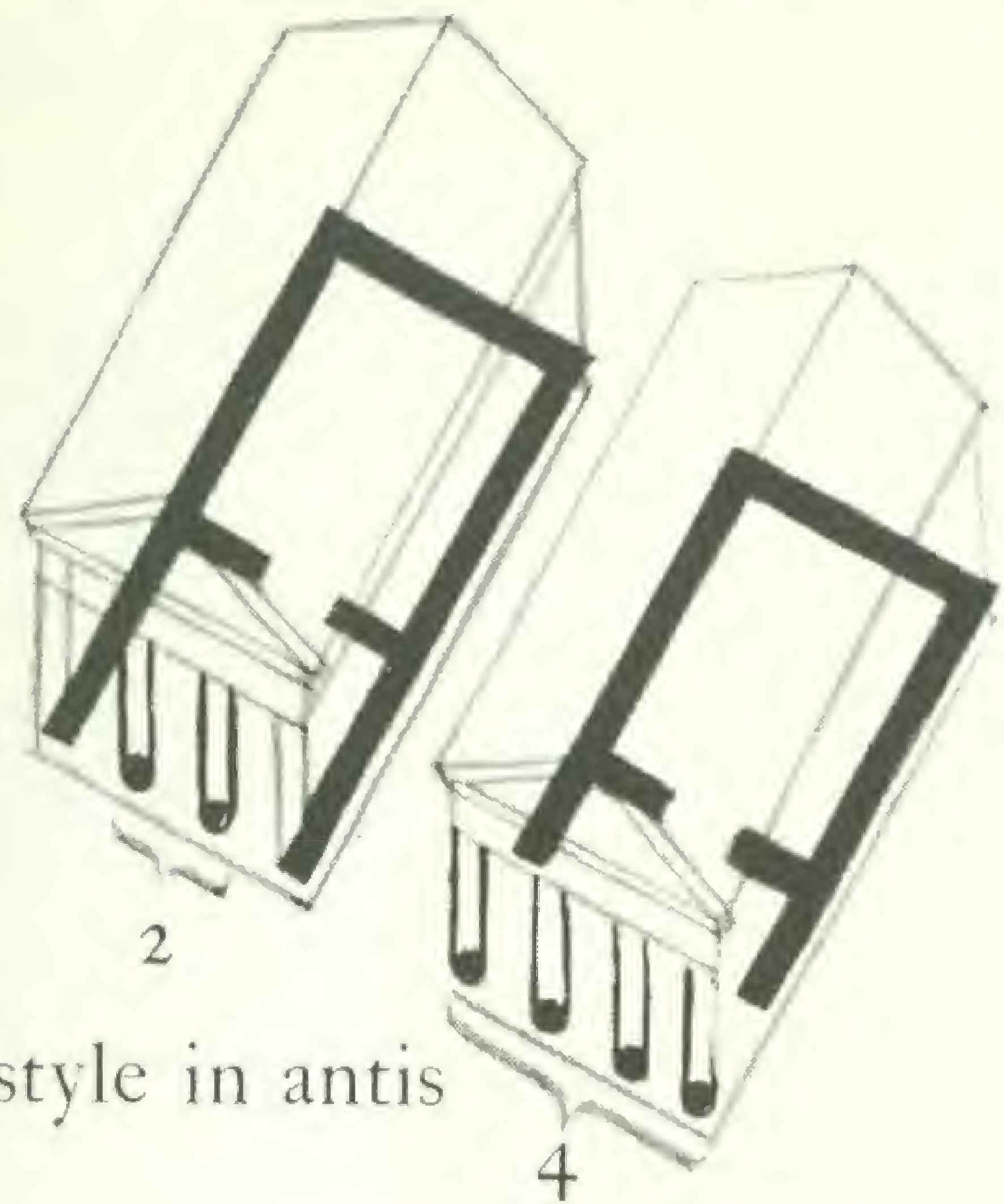


Arch of
Titus,
Rome, A.D. 81



From
*The Five Orders
of Architecture*
by Vignola
(A.D. 1509-73)

GREEK



2

4

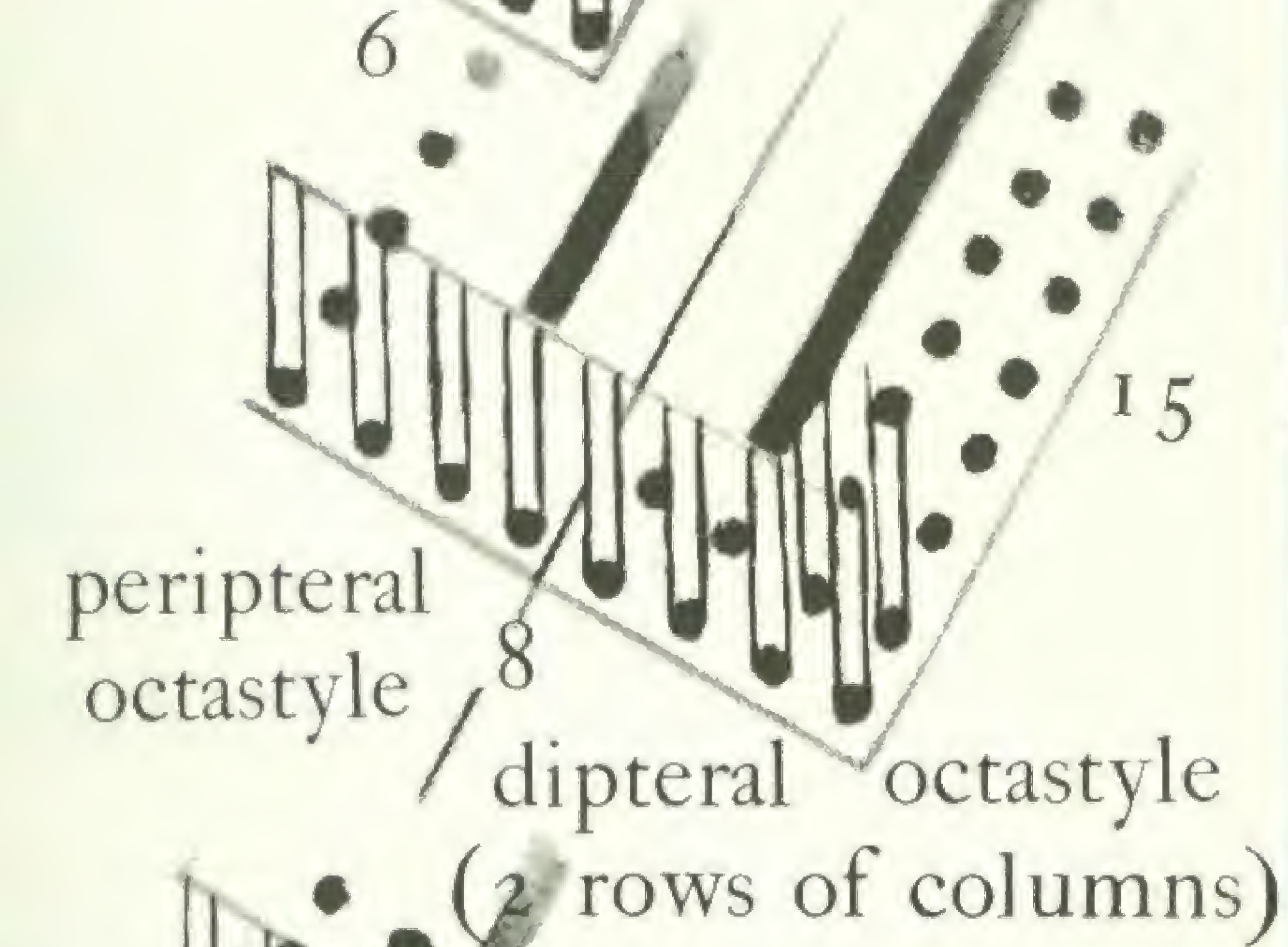
distyle in antis

prostyle tetrastyle



11

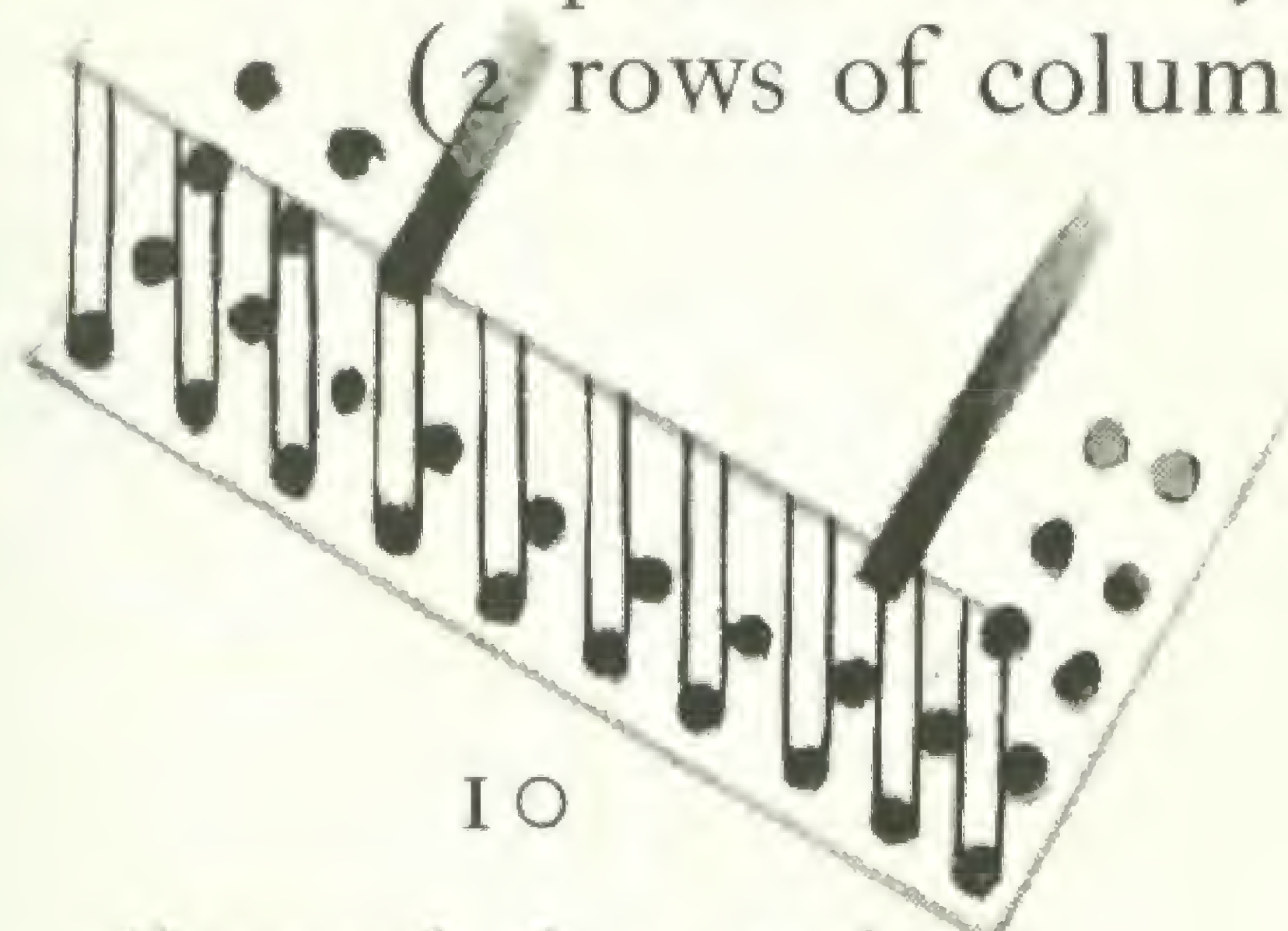
6



15

peripteral octastyle

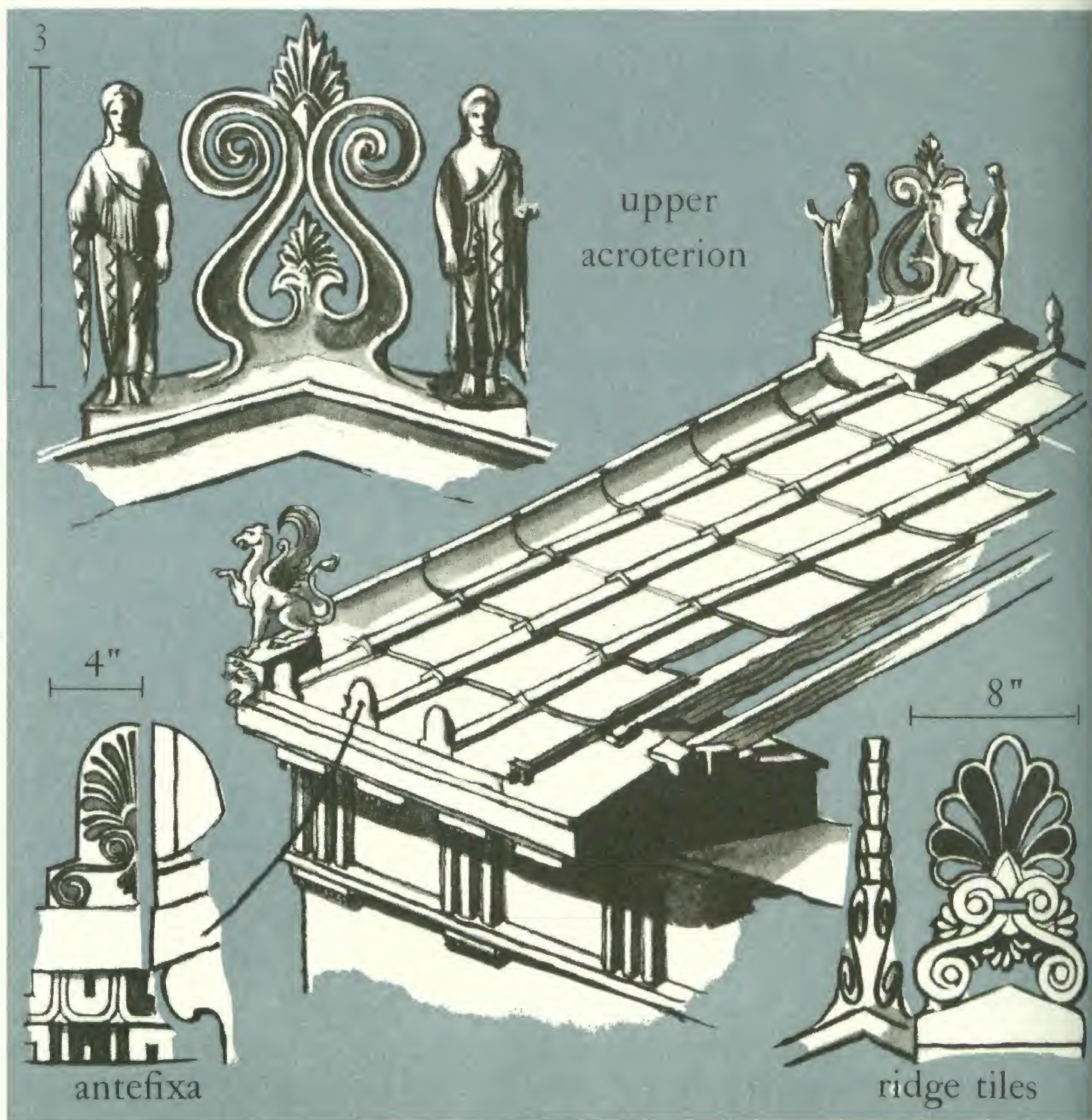
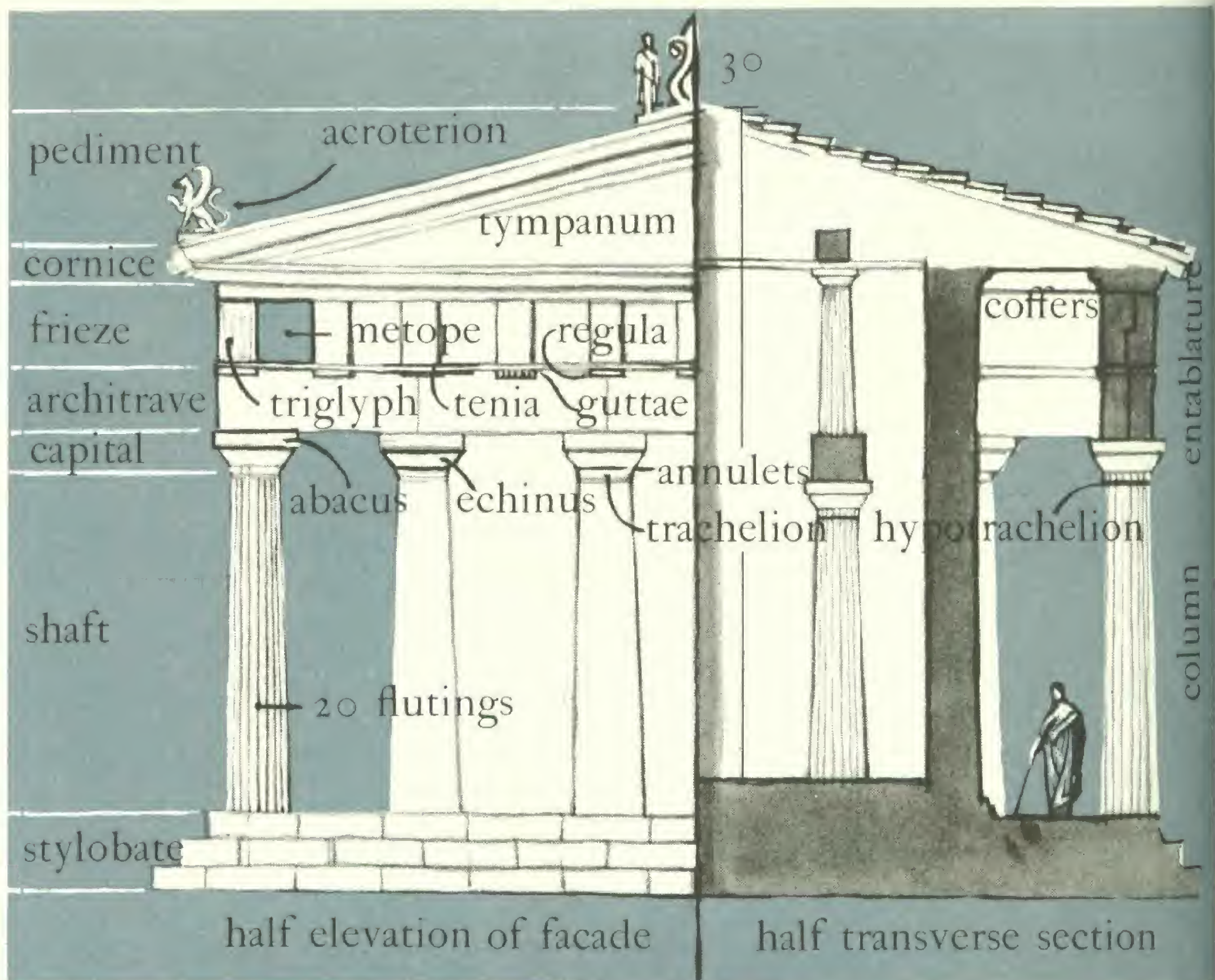
dipteral octastyle (2 rows of columns)



10

dipteral decastyle

Classification of columnan arrangement according to Vitruvius (I 11, 2)



upper acroterion

4"

8"

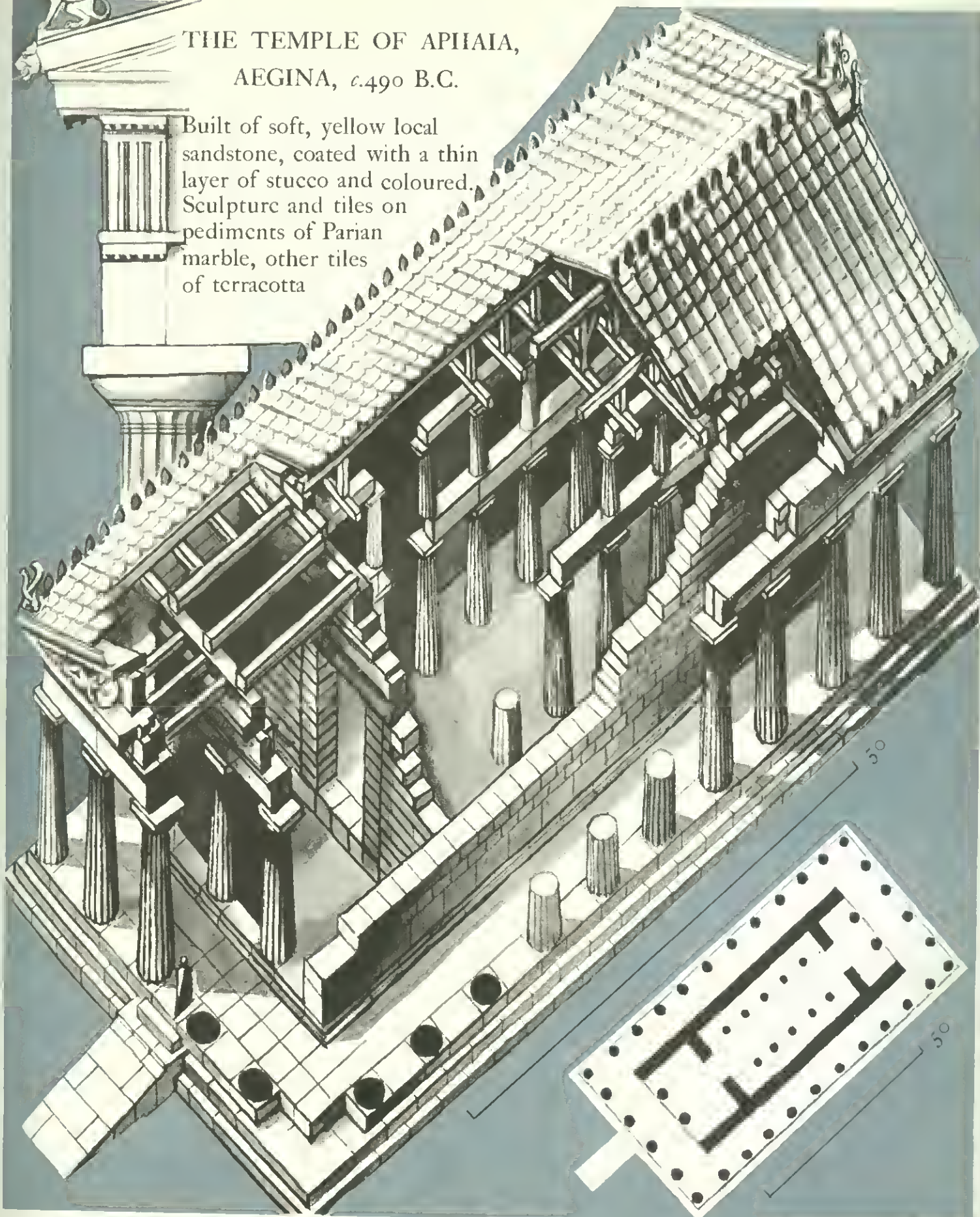
antefixa

ridge tiles

THE DORIC TEMPLE

THE TEMPLE OF APHIAIA, AEGINA, c.490 B.C.

Built of soft, yellow local sandstone, coated with a thin layer of stucco and coloured. Sculpture and tiles on pediments of Parian marble, other tiles of terracotta



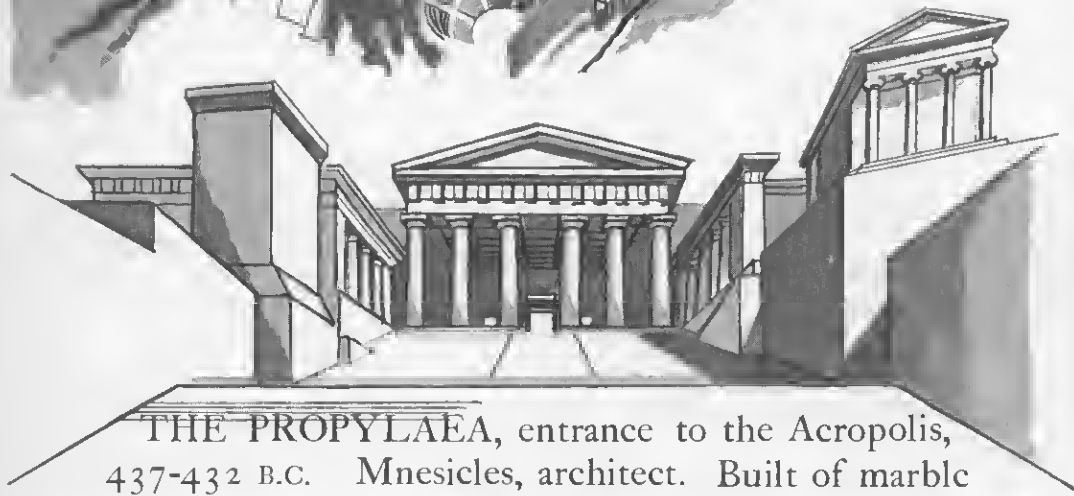
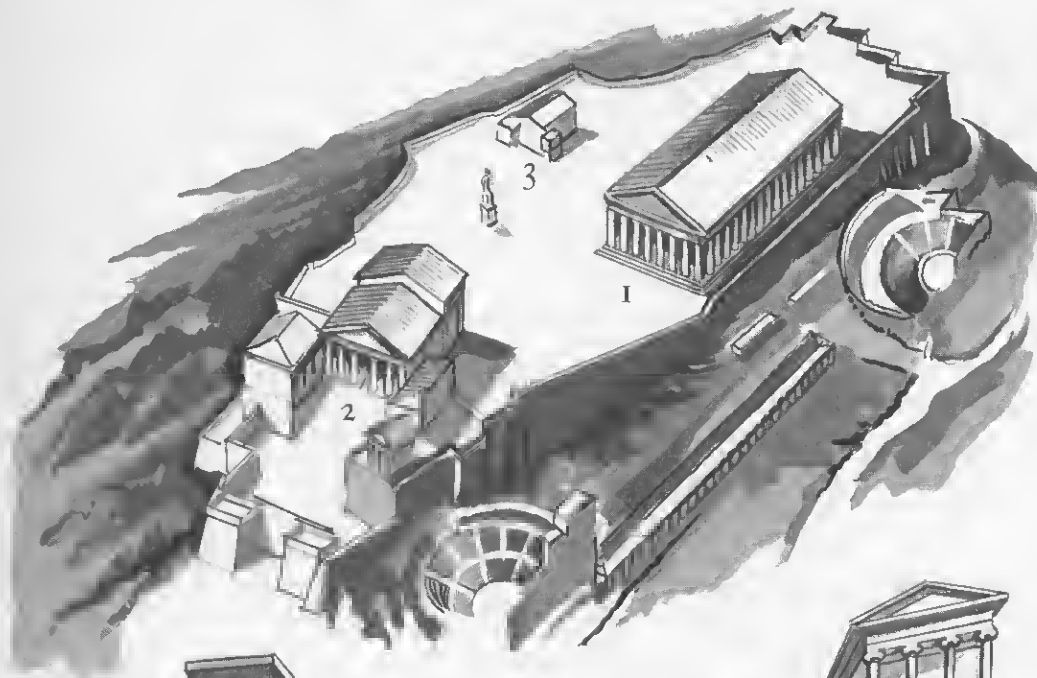
GREEK

ATHENS,

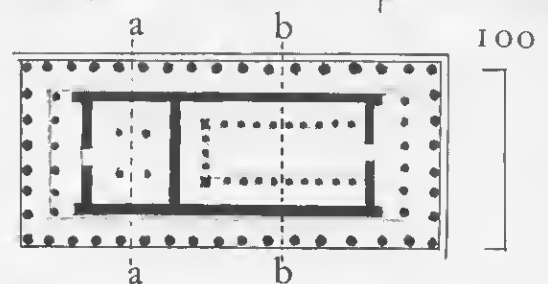
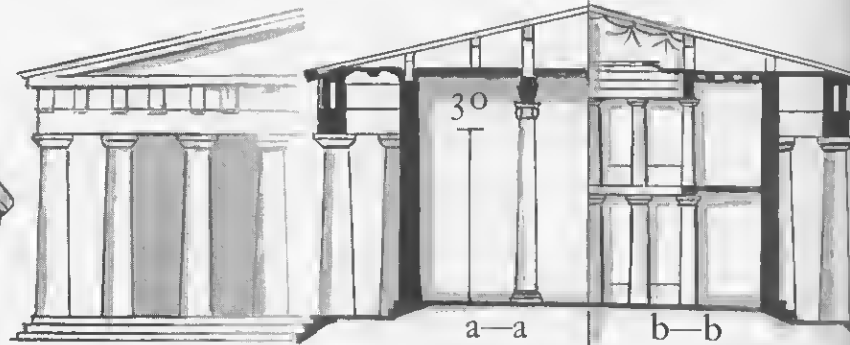
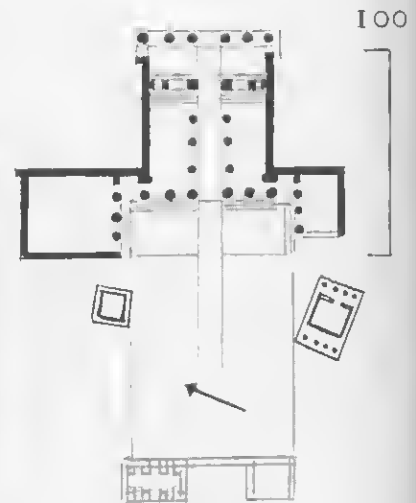
Between the Greeks' defeat of the Persians in 479 B.C. and the Peloponnesian War (431-404 B.C.)

Athens rose to her zenith, under the leadership of Pericles buildings were erected on the Acropolis:

- 1 The Parthenon
- 2 The Propylaea
- 3 The Erechtheum (restored)

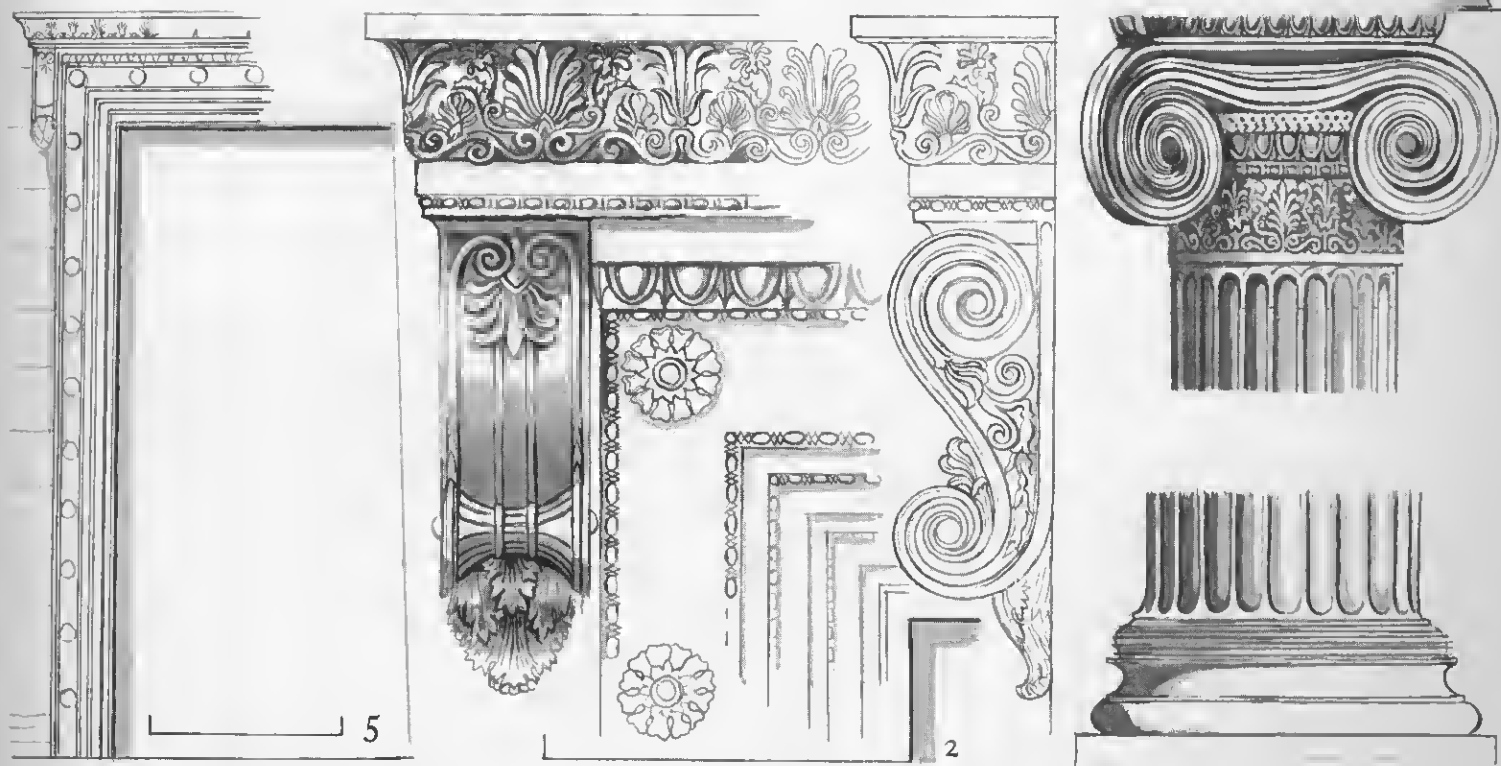
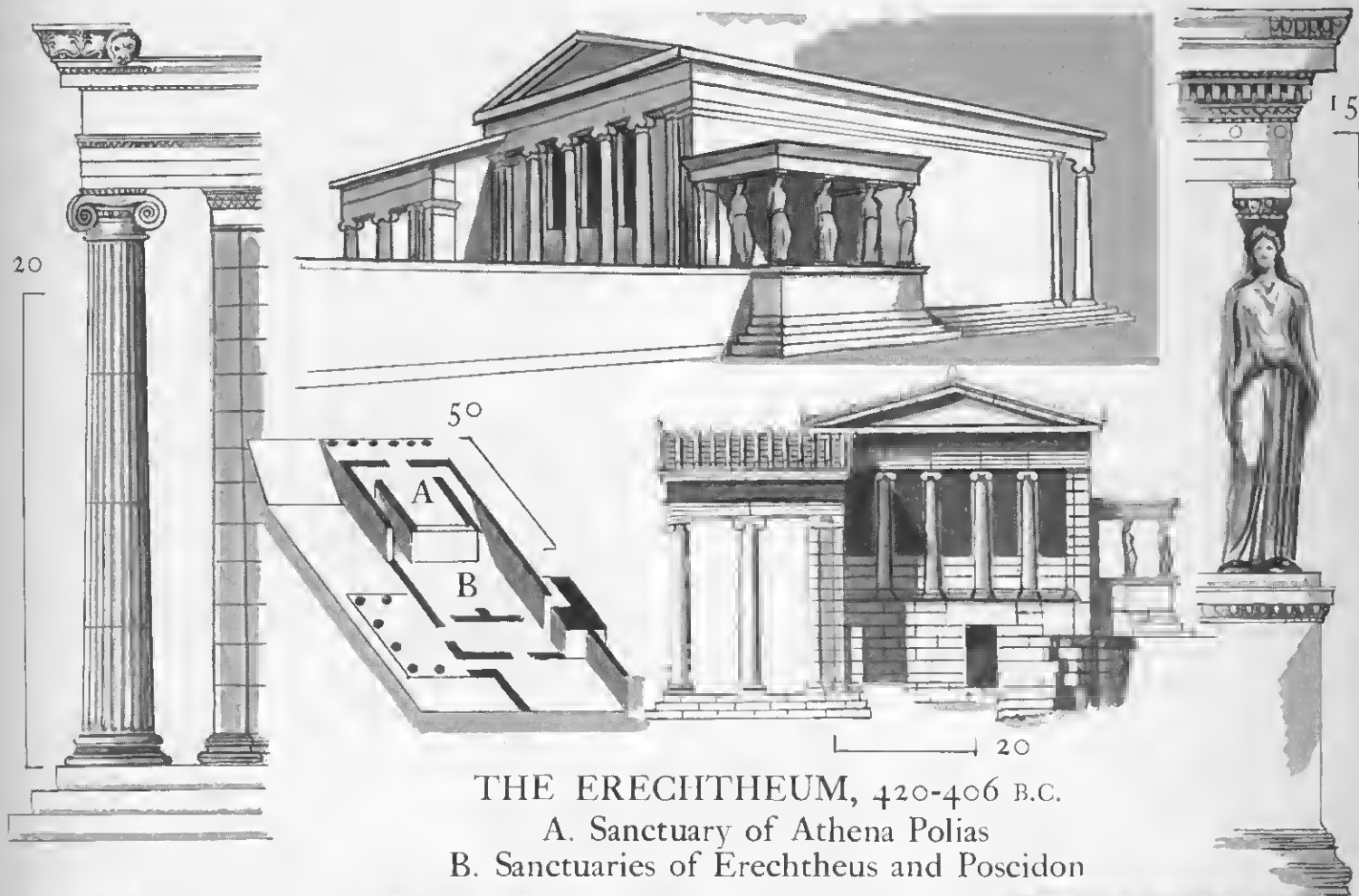


THE PROPYLAEA, entrance to the Acropolis, 437-432 B.C. Mnesicles, architect. Built of marble



THE PARTHENON, 447-432 B.C. Doric temple dedicated to Athena. Ictinus and Callicrates, architects; Phidias, master sculptor. Optical refinements p. 38

BUILDINGS ON THE ACROPOLIS

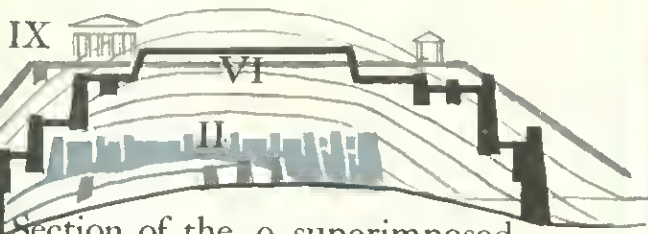


Possible architect Mnesicles. The caryatids and column capitals may have been designed by Callimachus, inventor of the Corinthian capital. Built on 4 levels, irregular in plan to preserve places sacred to Athens; built of white marble

GREEK

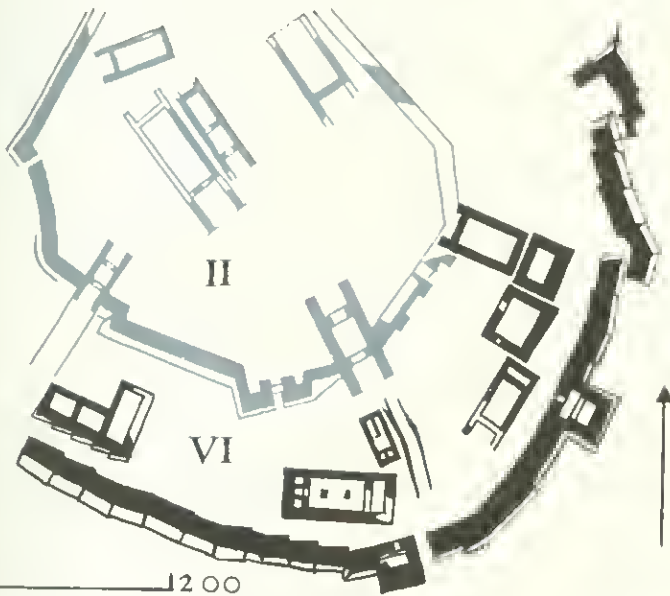
CITY

AEGEAN



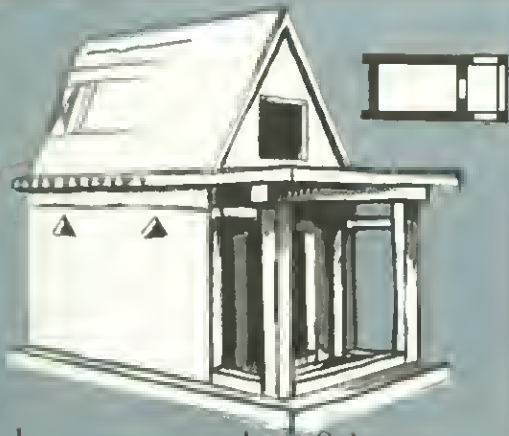
Section of the 9 superimposed
'cities' of TROY

- II Prehistoric citadel, c.2600-2300 B.C.
- VI Homeric Troy, 1900 B.C.; sacked c.1200 B.C.
- IX The Roman acropolis, c.30 B.C.-A.D. 14.



Plan of selected buildings, Troy

- II Prehistoric citadel
- VI Homeric Troy



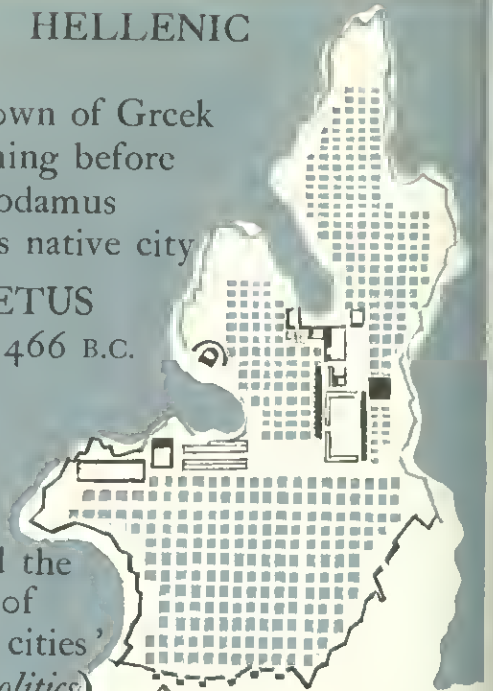
A house or temple, c.8th cent. B.C.
after a terracotta model
from Argive Heraeum

HELLENIC

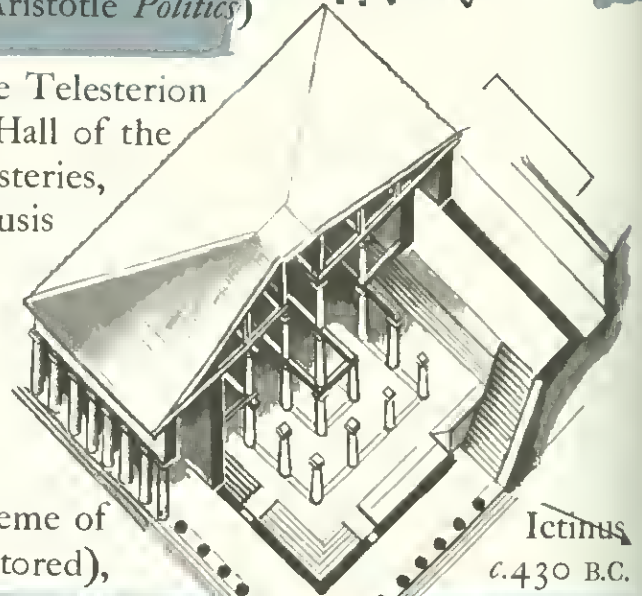
Little is known of Greek
city planning before
Hippodamus
laid out his native city

MILETUS
c.479 or 466 B.C.

and
'discovered the
method of
dividing up cities'
(Aristotle *Politics*)



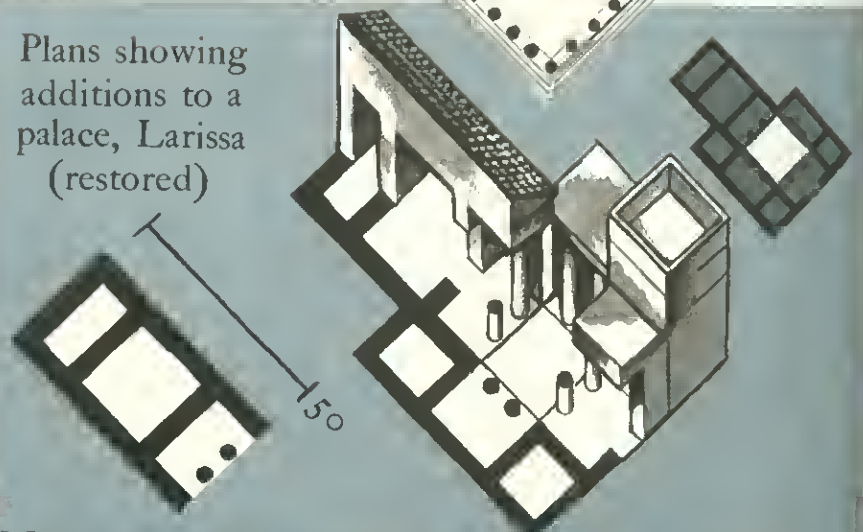
The Telesterion
or Hall of the
Mysteries,
Eleusis



Scheme of
(restored),

Ictinus
c.430 B.C.

Plans showing
additions to a
palace, Larissa
(restored)

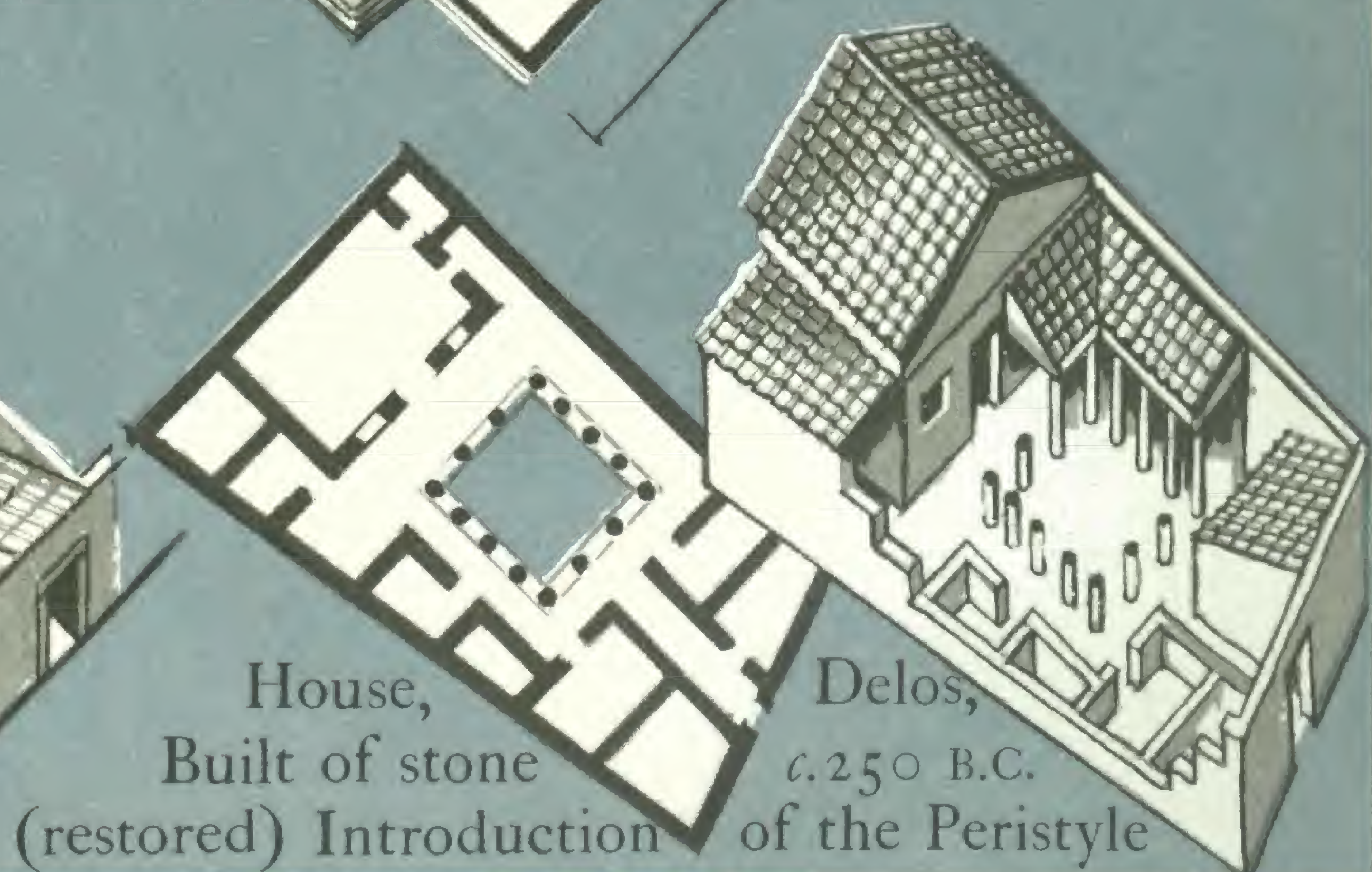
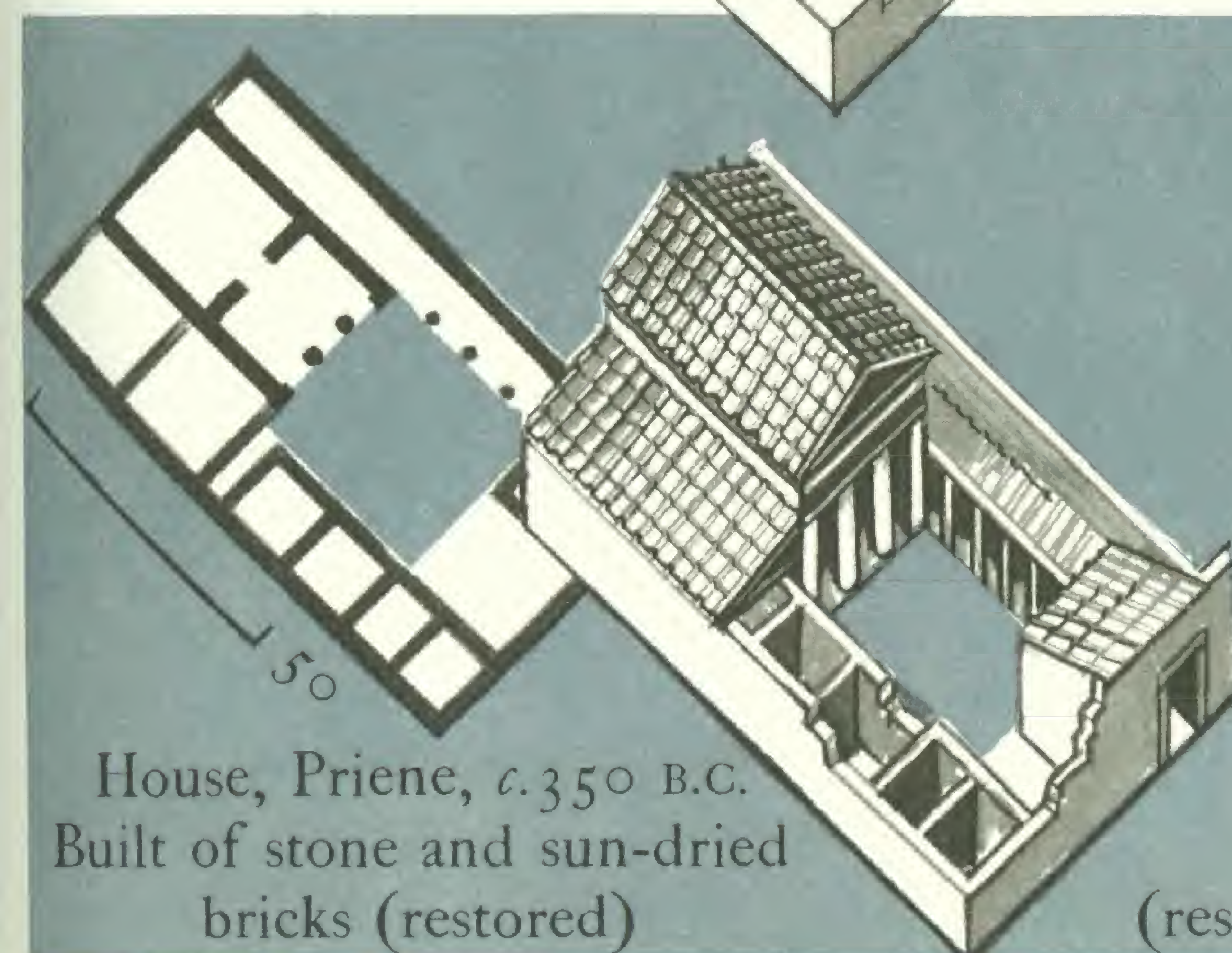
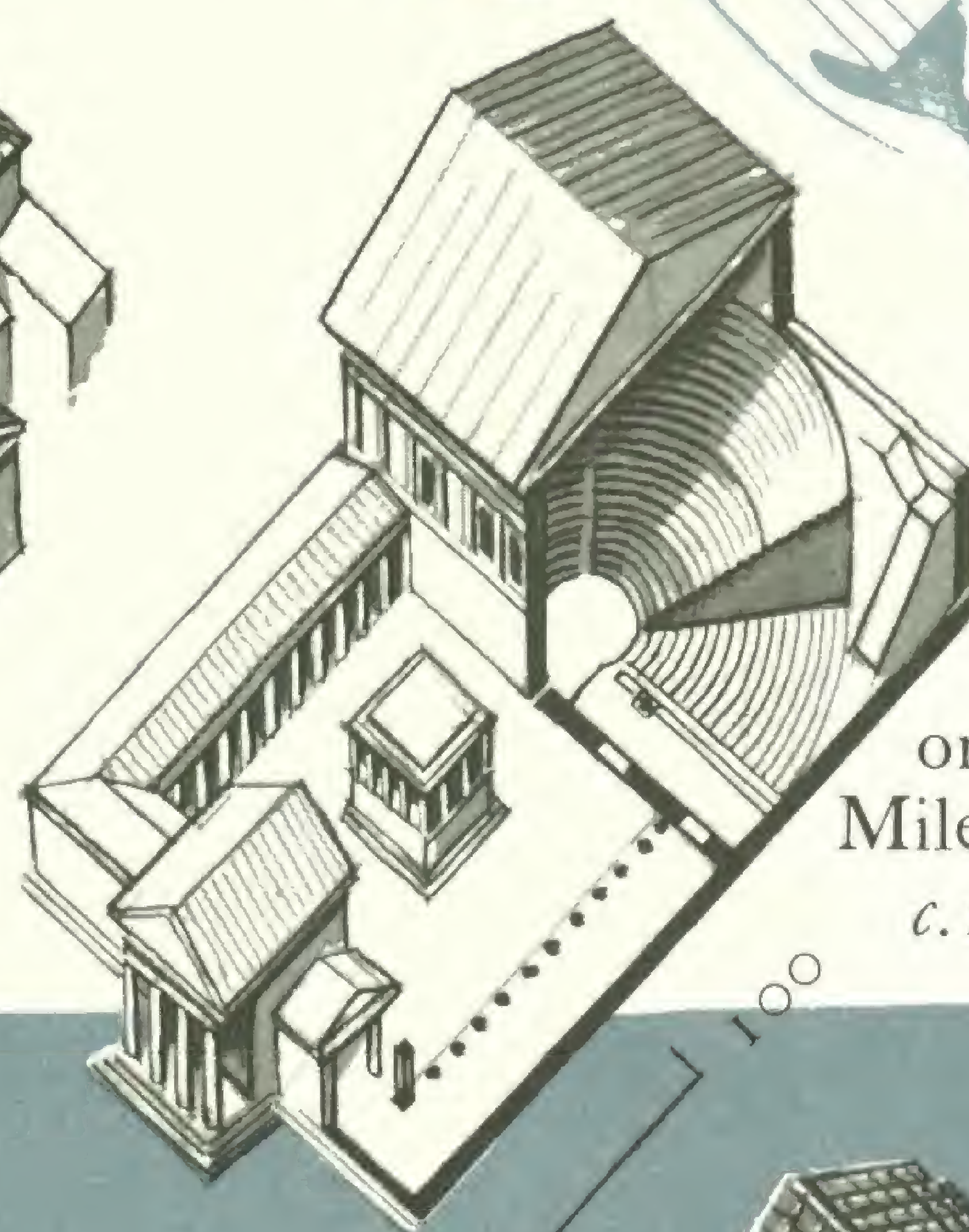
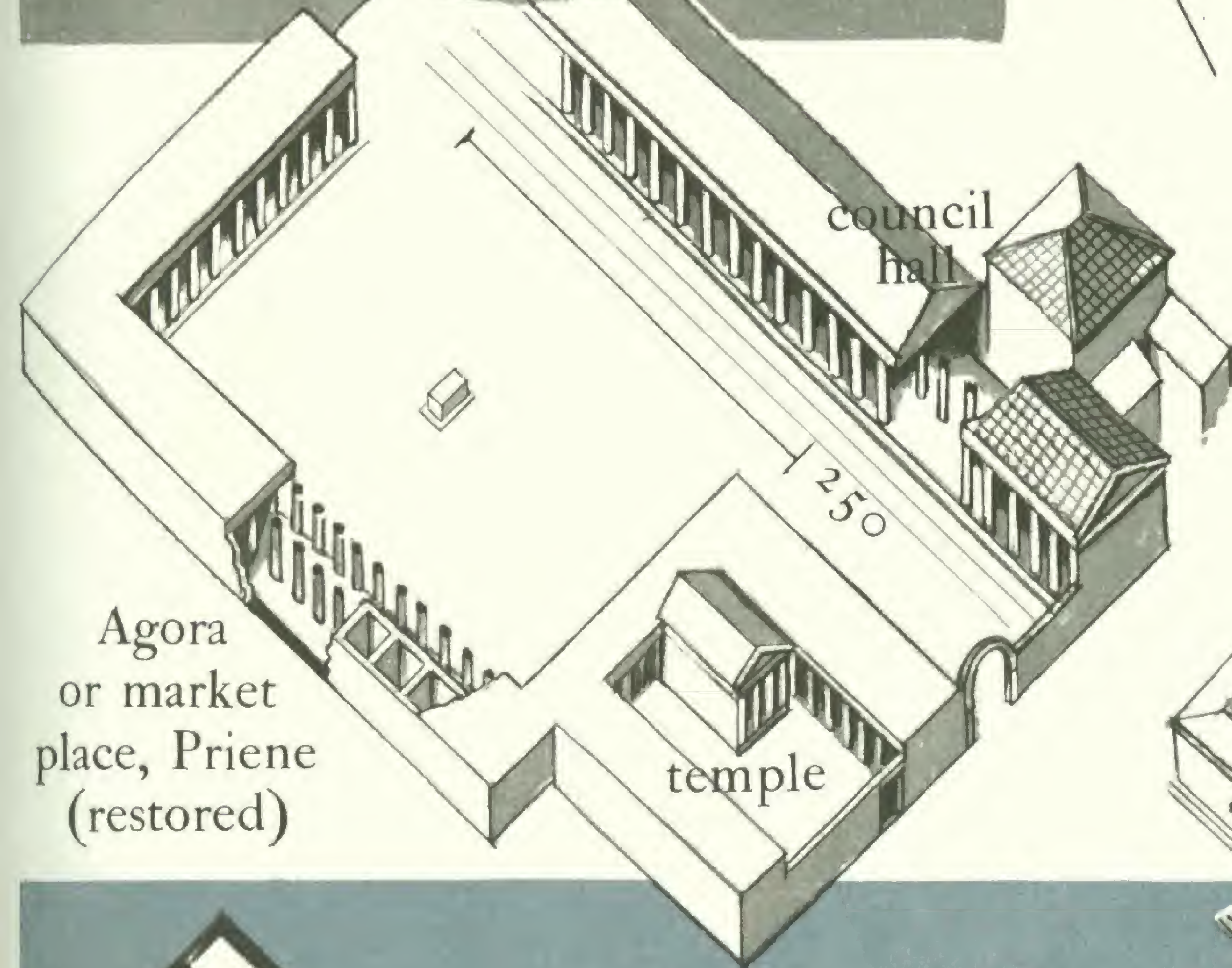
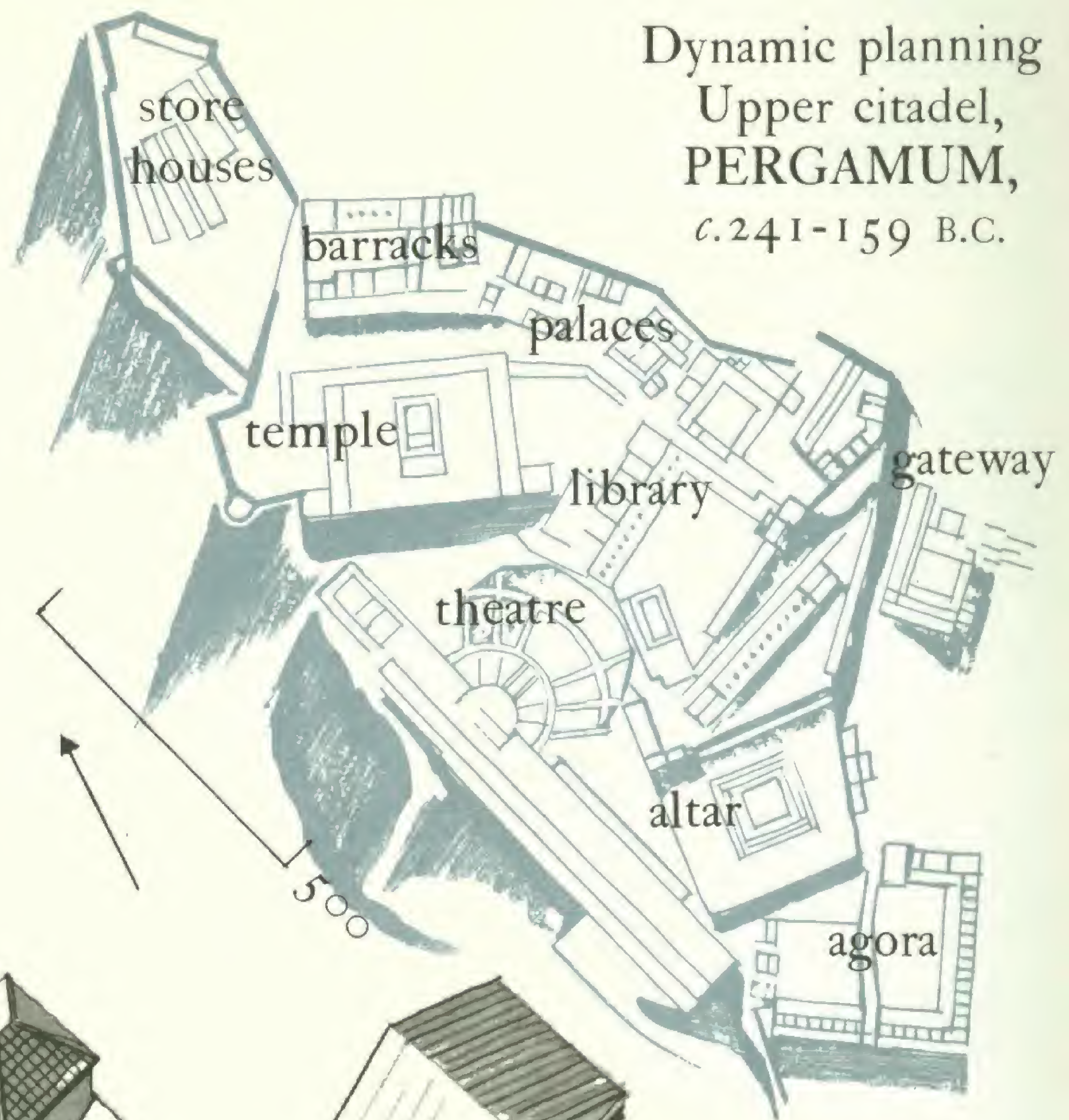


Megaron, c.500 B.C.

Peristyle, c.450 B.C.

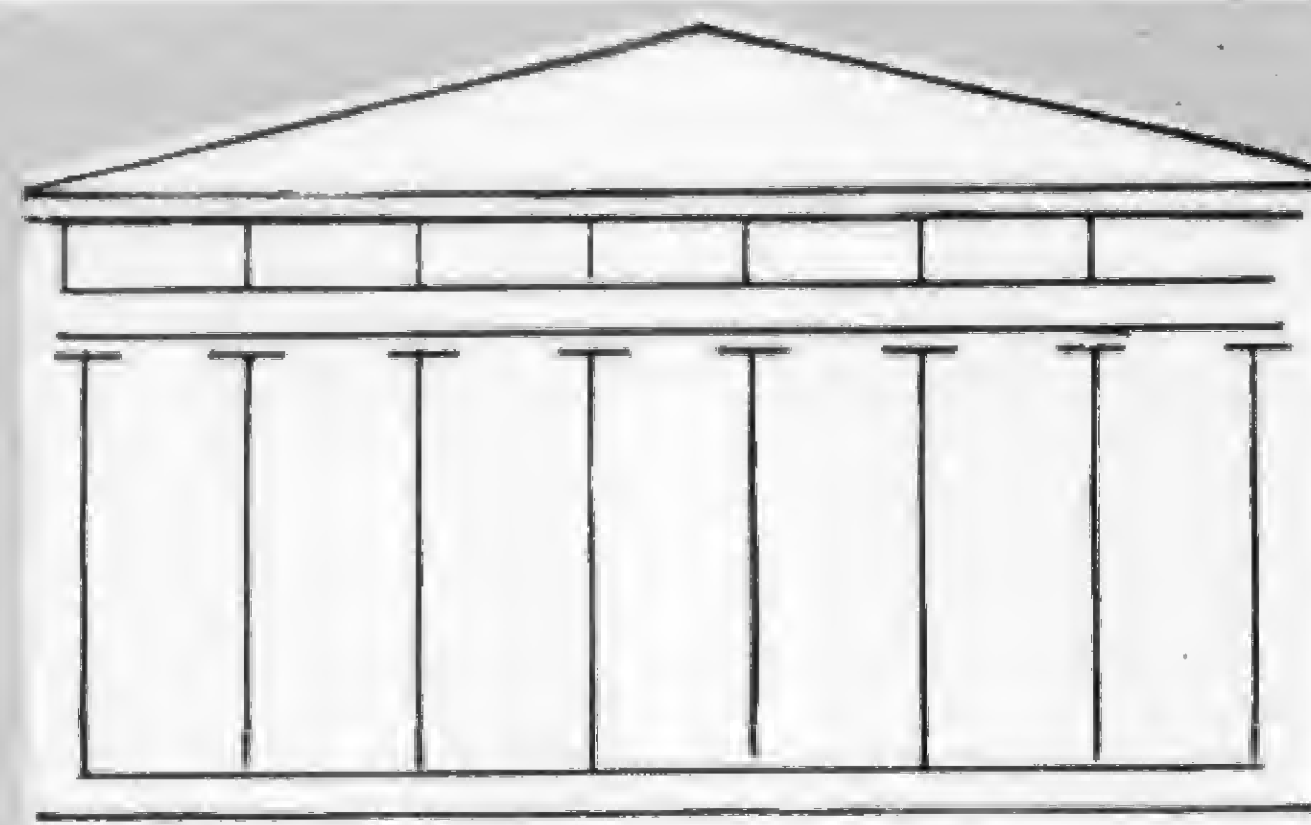
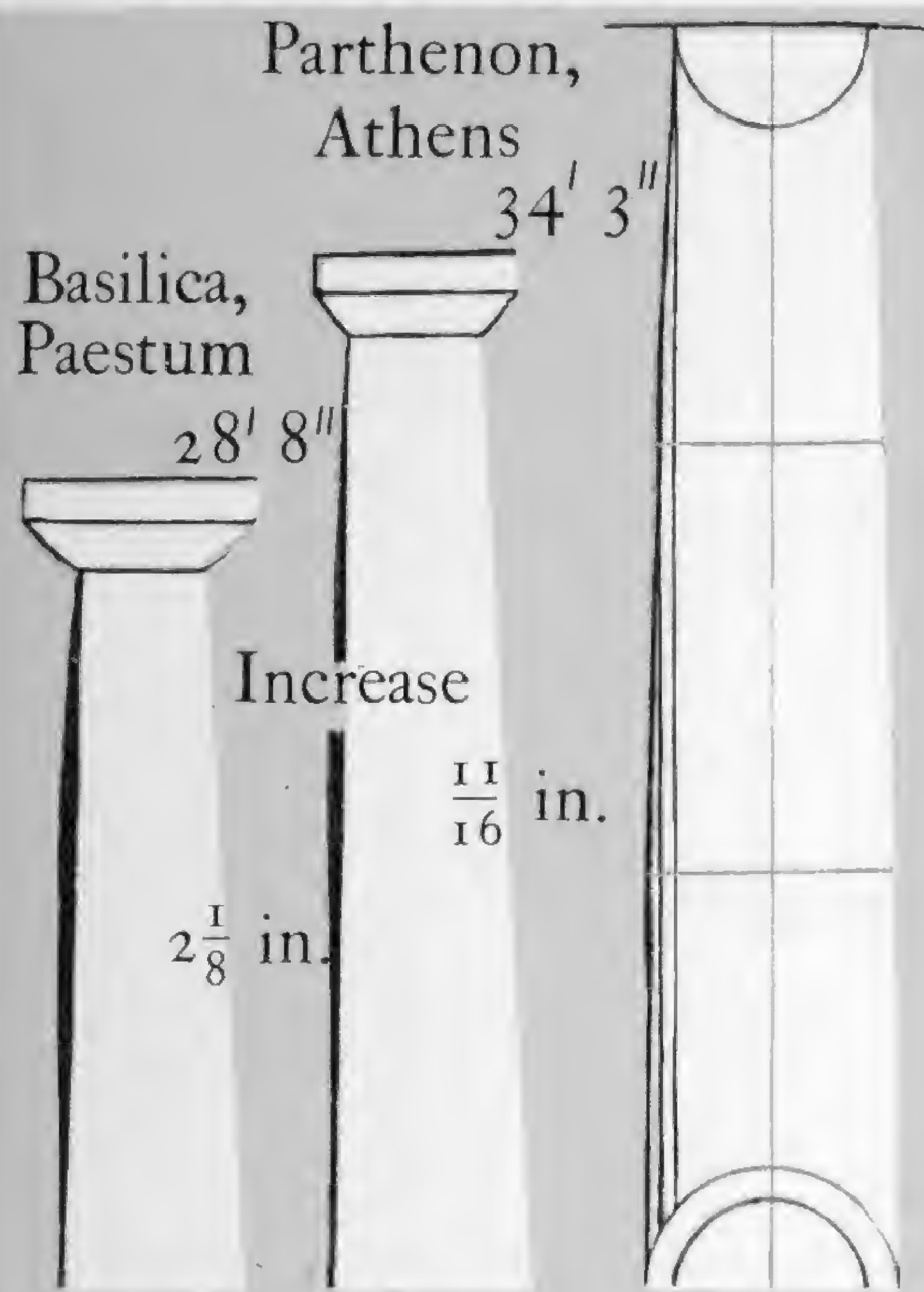
PLANS, BUILDINGS AND HOUSES

HELLENISTIC

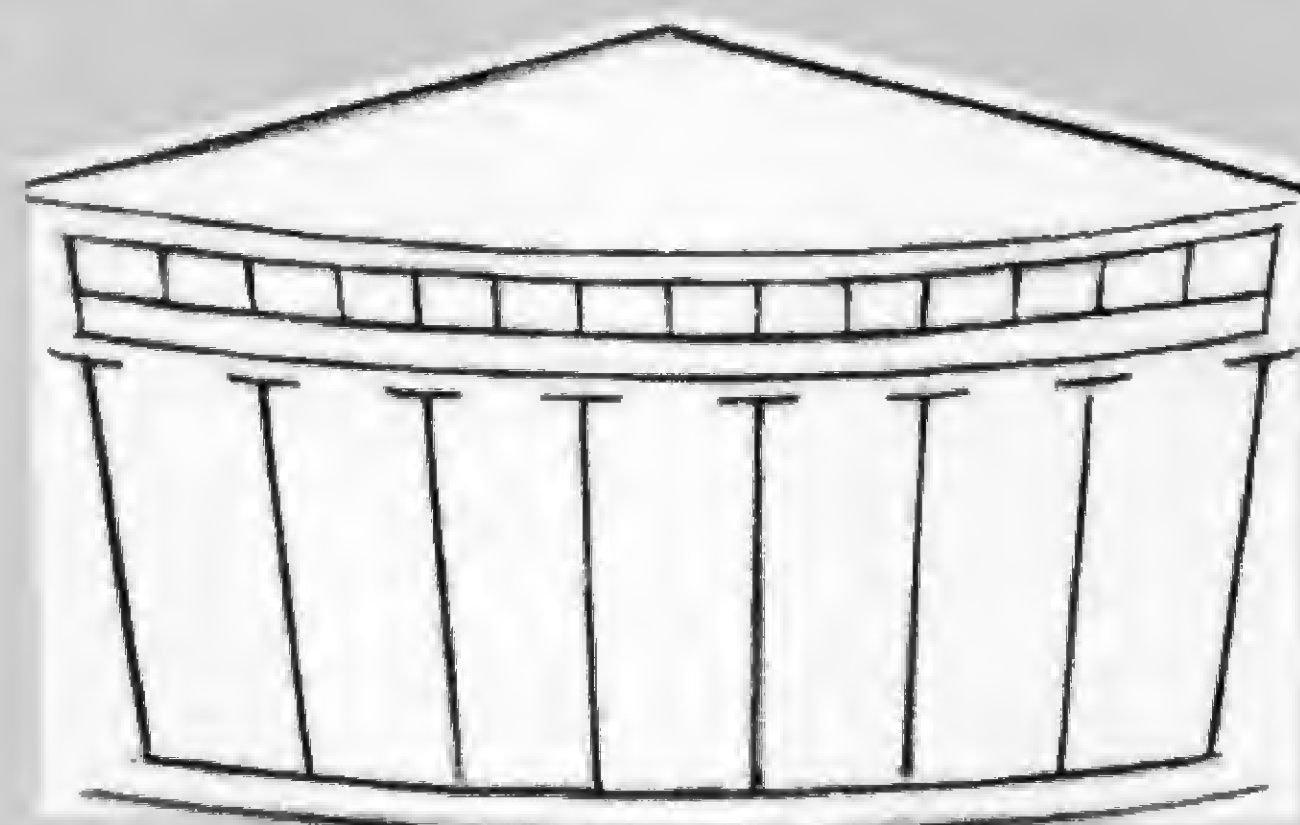


GREEK

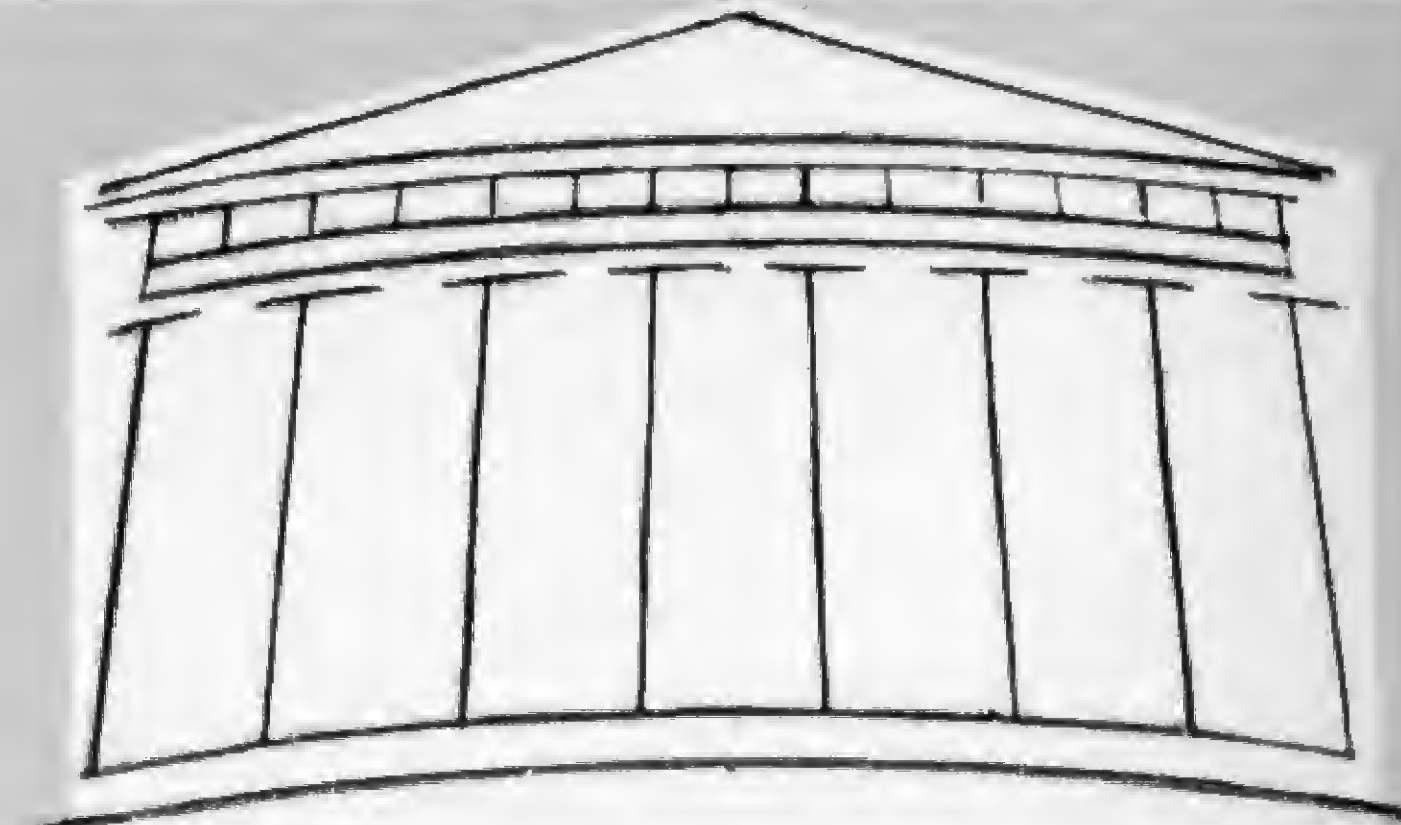
REFINEMENTS



1 The Parthenon as seen

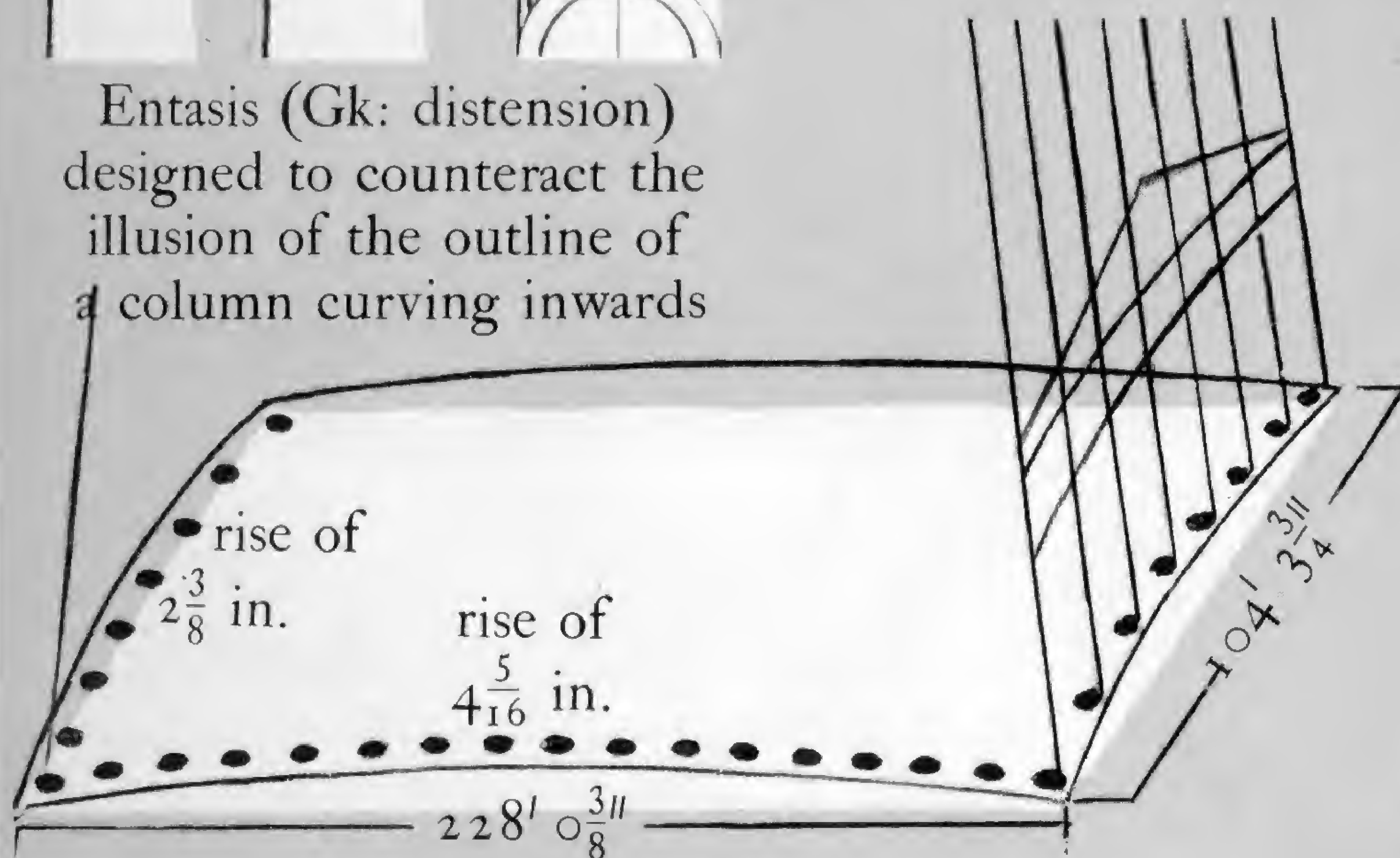


2 Without optical corrections

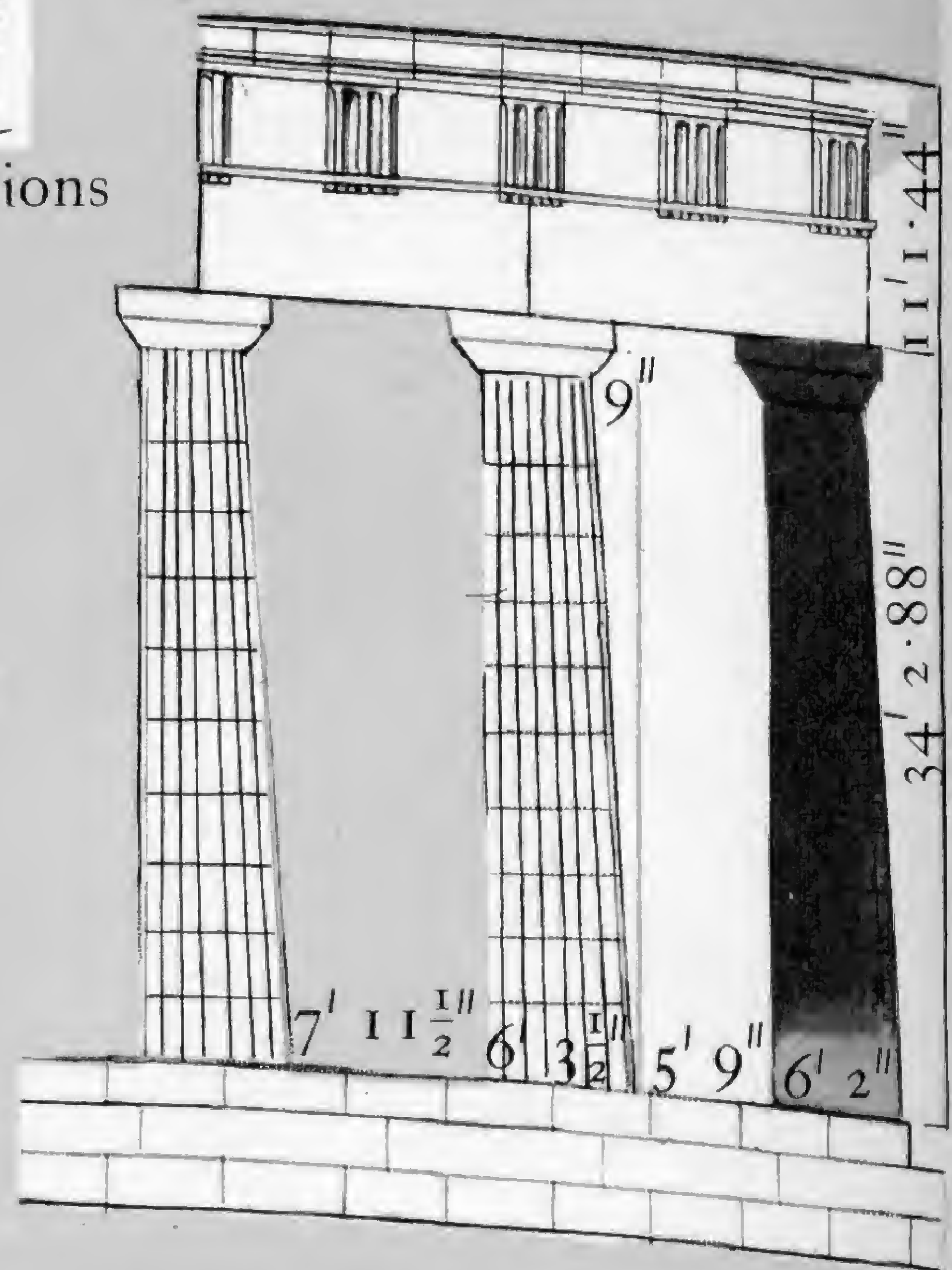


3 The front with inclined axes of columns and with convex stylobate and entablature producing the result seen at 1

Entasis (Gk: distension) designed to counteract the illusion of the outline of a column curving inwards

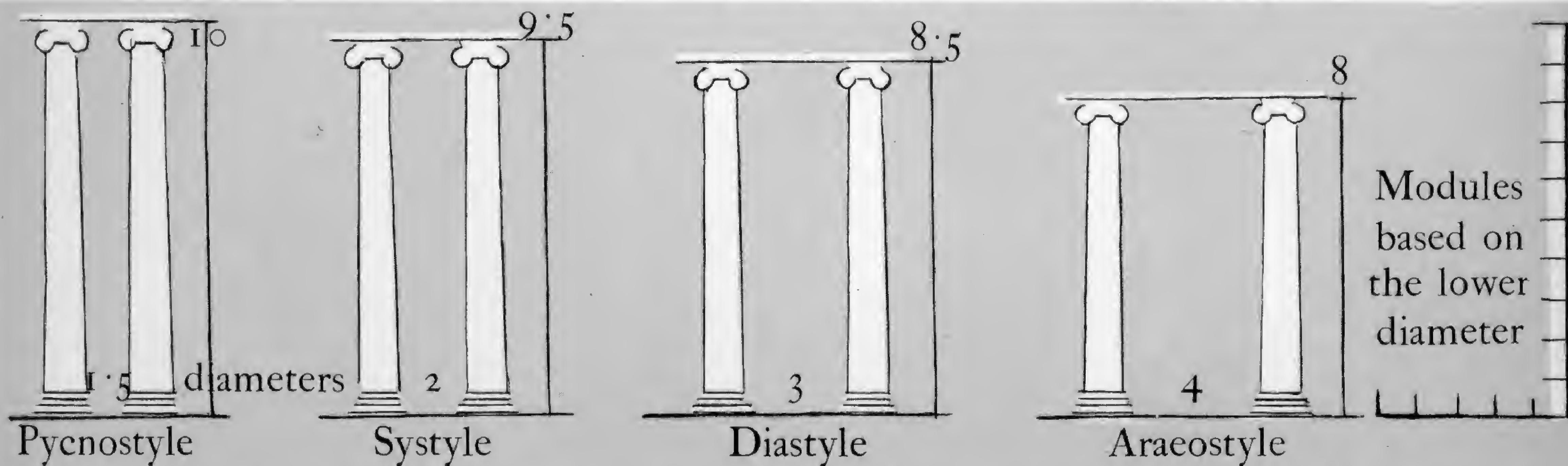


Exaggerated diagram of the rising curvature of the stylobate and inward inclination of the columns

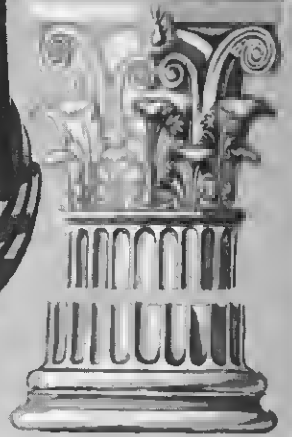
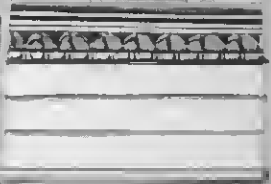
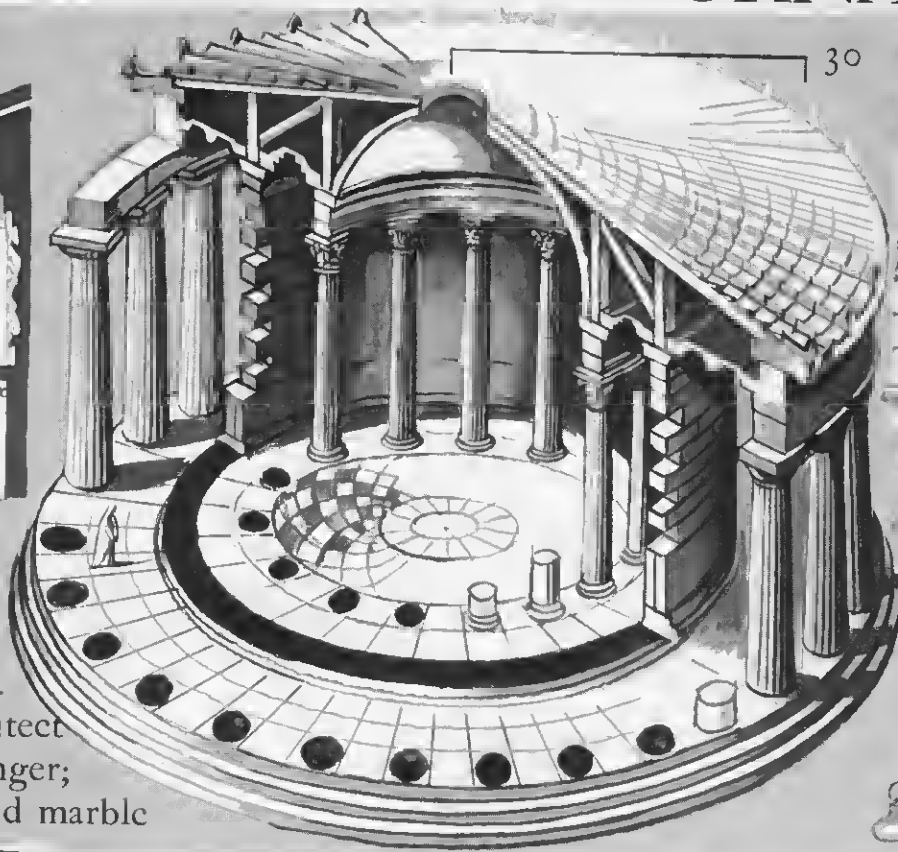
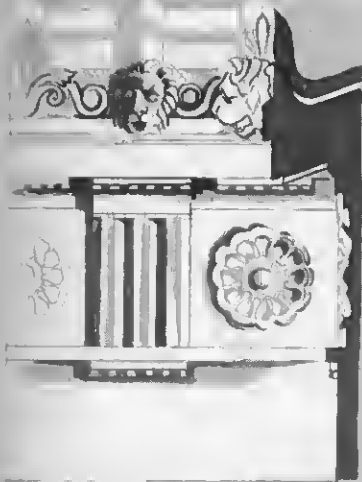


Angle columns look thinner seen dark against light and are thickened by 1 1/2 in.

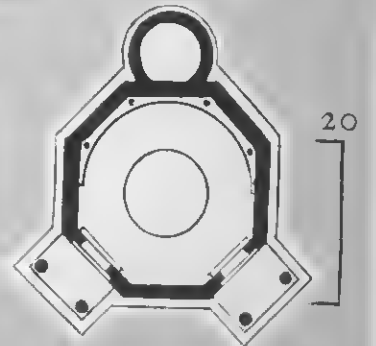
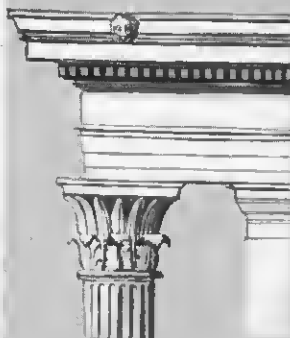
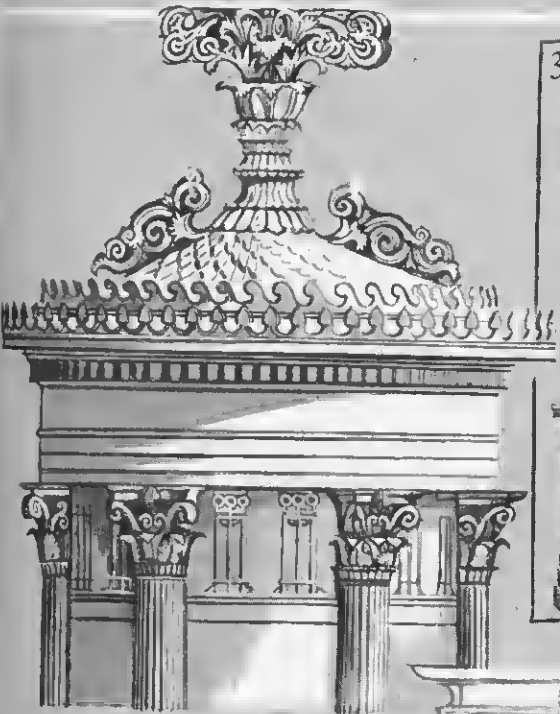
OPTICAL CORRECTIONS, THE PARTHENON, ATHENS



Proportions of height, thickness & distance apart of columns according to Vitruvius (III,3)



The Tholos,
Epidauros, c. 360 B.C.
by the sculptor-architect
Polycleitus the Younger;
built of sandstone and marble



The Choragic
Monument of Lysicrates,
Athens, c. 334 B.C.
Podium of limestone,
upper part white marble,
Corinthian order used
externally for the first time

The Tower of the Winds, Athens,
c. 50 B.C. Clock-tower built of marble

ROMAN

THE ROMAN REPUBLIC

c.753 B.C.
The foundation
of Rome

Etruscan
kings

500



200 miles



Roman territory



500 miles

Italy at the beginning
of the Roman Republic,
c.500 B.C.

The Latin conquest
of Italy,
275 B.C.

The Roman Empire

Early Rome, with its Republican magistrates, town-council (senatus) and town-meetings (comitia), by a series of systematic conquests created an Empire round the Mediterranean consisting of different nationalities accepted as allies. The Roman Empire became a fusion of the practical Western idea of one universal society in which all men might live in conformity with Roman law and the Oriental conception of an Emperor-God with a throne-altar demanding a common worship and loyalty. This union between the West and the East was a continual source of weakness and led to the ultimate division of the Empire. The Romans built roads and bridges for swift communication, military camps with a simple set plan (later incorporated in many city-plans) for speed of construction, and government and civic buildings, which were both useful and symbolic of Roman law and order.

Greek Hellenic Period

Hellenistic

775/6

429/8 — Plato — 347
384 Aristotle 322

342-Epicurus-270

326? — Zeno — 264? (Stoicism)

INTRODUCTION

THE ROMAN EMPIRE

29 A.D.					284	324	394	476 A.D.
Julius Caesar	Augustus	Nero	Trajan	Septimus Severus	The capital, Rome, moved to Byzantium by Constantine			End of the Western Empire
106—44	27—14	59—68	98—117	192—211	306—337			
		Vespasian	Hadrian					
		69—79	117—138					



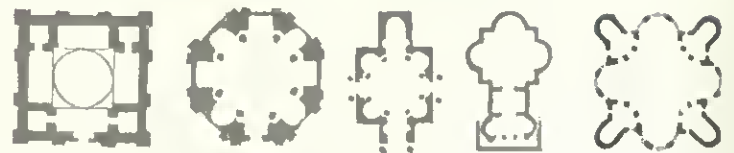
27 B.C. — A.D. 324



The Division of the Empire

394 A.D.

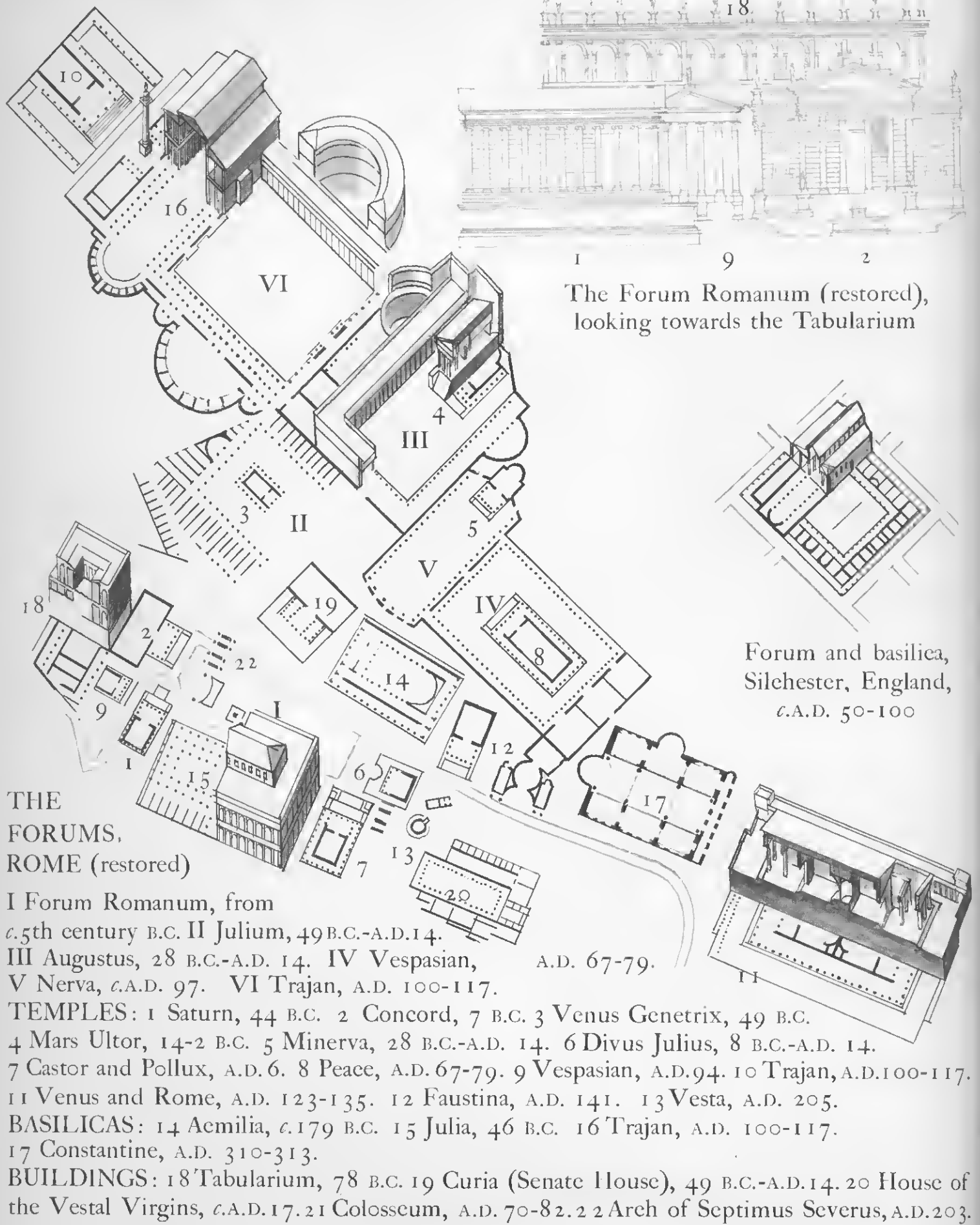
During the Republic kiln-baked bricks and stone blocks with or without mortar were used in building. The invention of concrete revolutionised construction in the Empire. Concrete was used with a facing for protection and a surface finish, & there is a sharp distinction between the art of the engineer constructing arches, vaults and domes and the applied art of decoration with columns and pilasters, marbles and mosaics.



The Romans invented all possible variations in the plans of buildings which were copied by later architects. *The Ten Books on Architecture* by Marcus Vitruvius Pollio, a Roman architect and engineer who lived in the 1st century B.C. was widely read in the Renaissance and later.

A.D.						
31					323	
106—43	Cicero				Christianity	
70—19	Virgil				the official religion	
65—8	Horace				of the Empire.	
59—17	Livy					
46?	Plutarch	120?	203—262	Plotinus	354	St Augustine 430

ROMAN



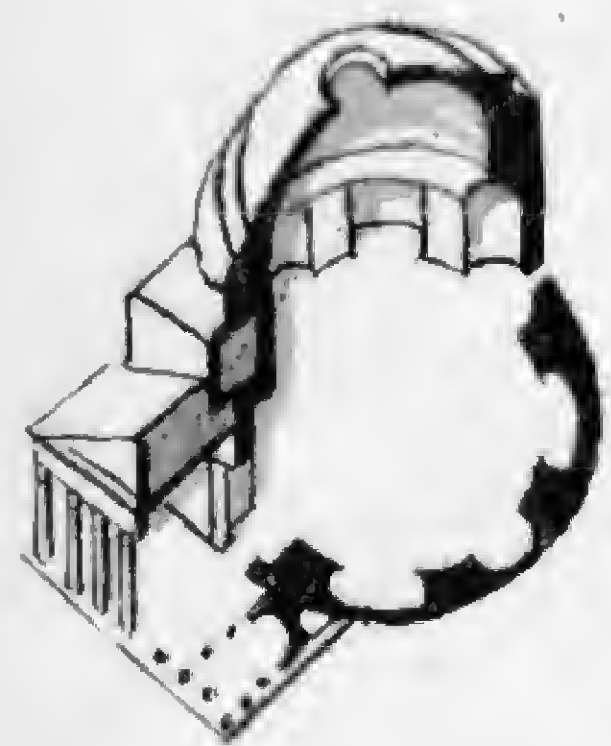
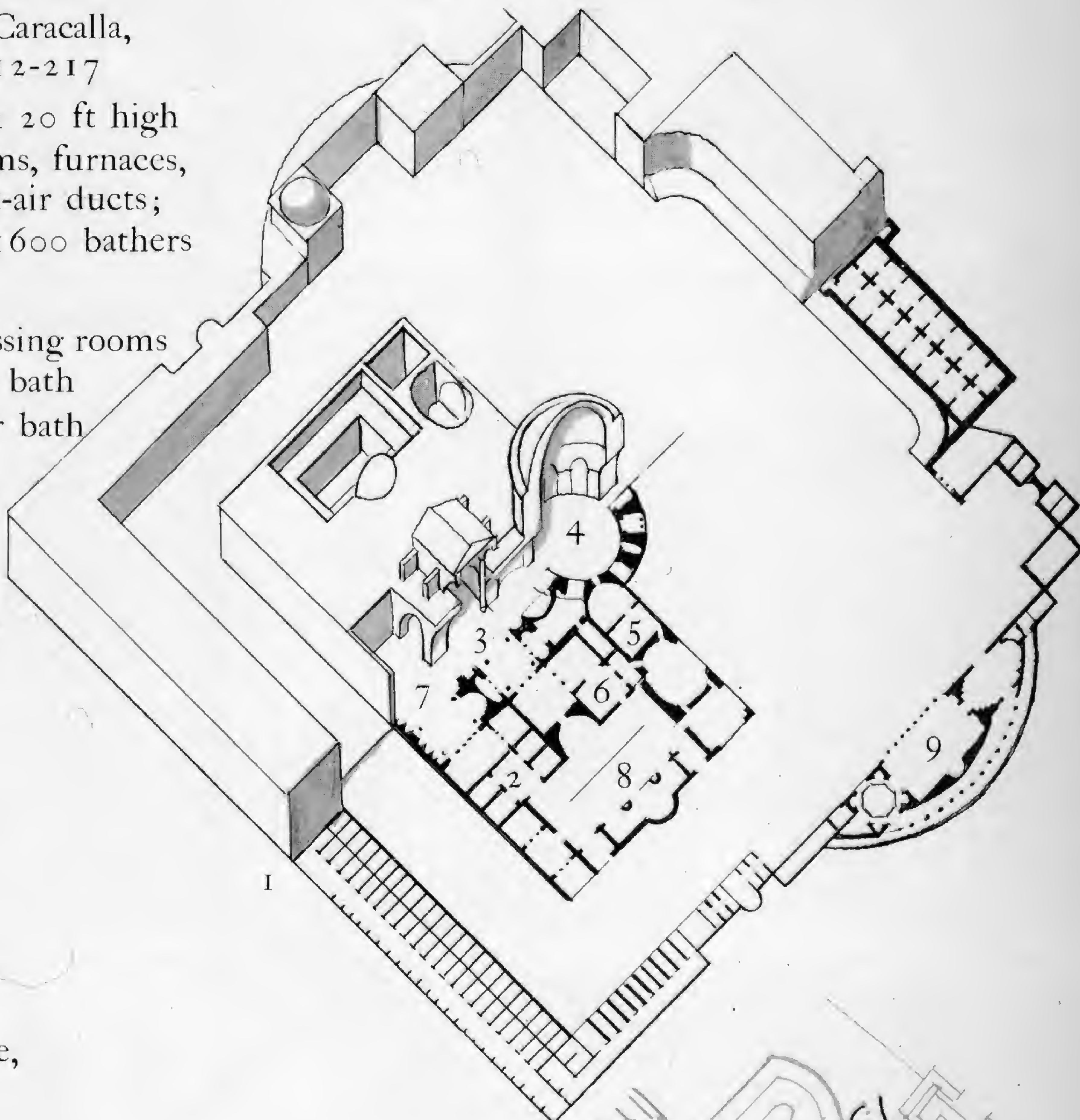
BUILDINGS AND PLANS, ROME

Drawn to the same scale  500

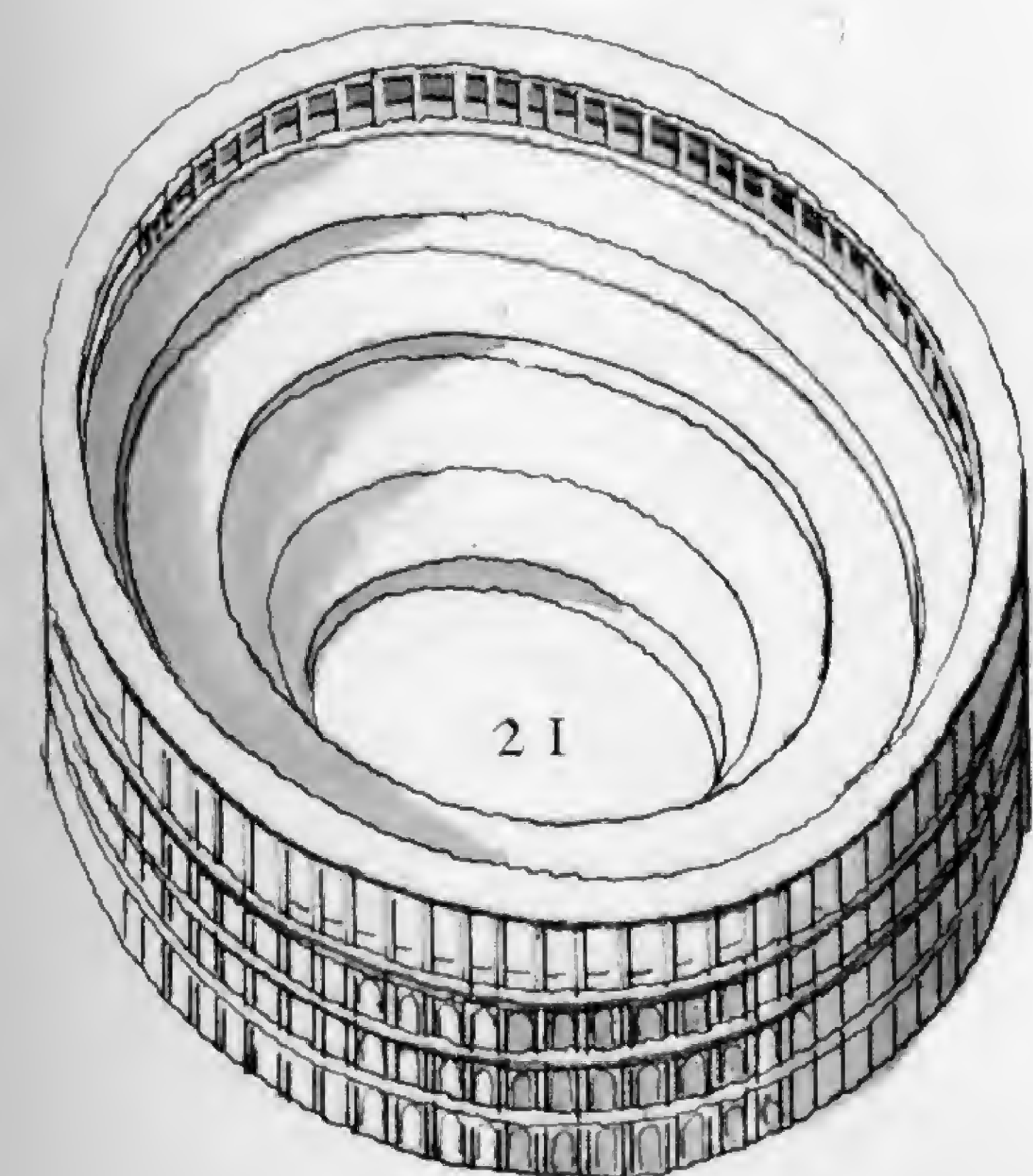
The Thermae of Caracalla, Rome, c. A.D. 212-217

Stands on a platform 20 ft high containing store-rooms, furnaces, hypocausts and hot-air ducts; room for more than 1600 bathers

- 1 Main entrance
- 2 Apodyteria—undressing rooms
- 3 Tepidarium—tepid bath
- 4 Calidarium—hot-air bath
- 5 Warm baths
- 6 Hot baths
- 7 Frigidarium—open-air cold bath
- 8 Palaestra, peristyles
- 9 Lecture halls and libraries

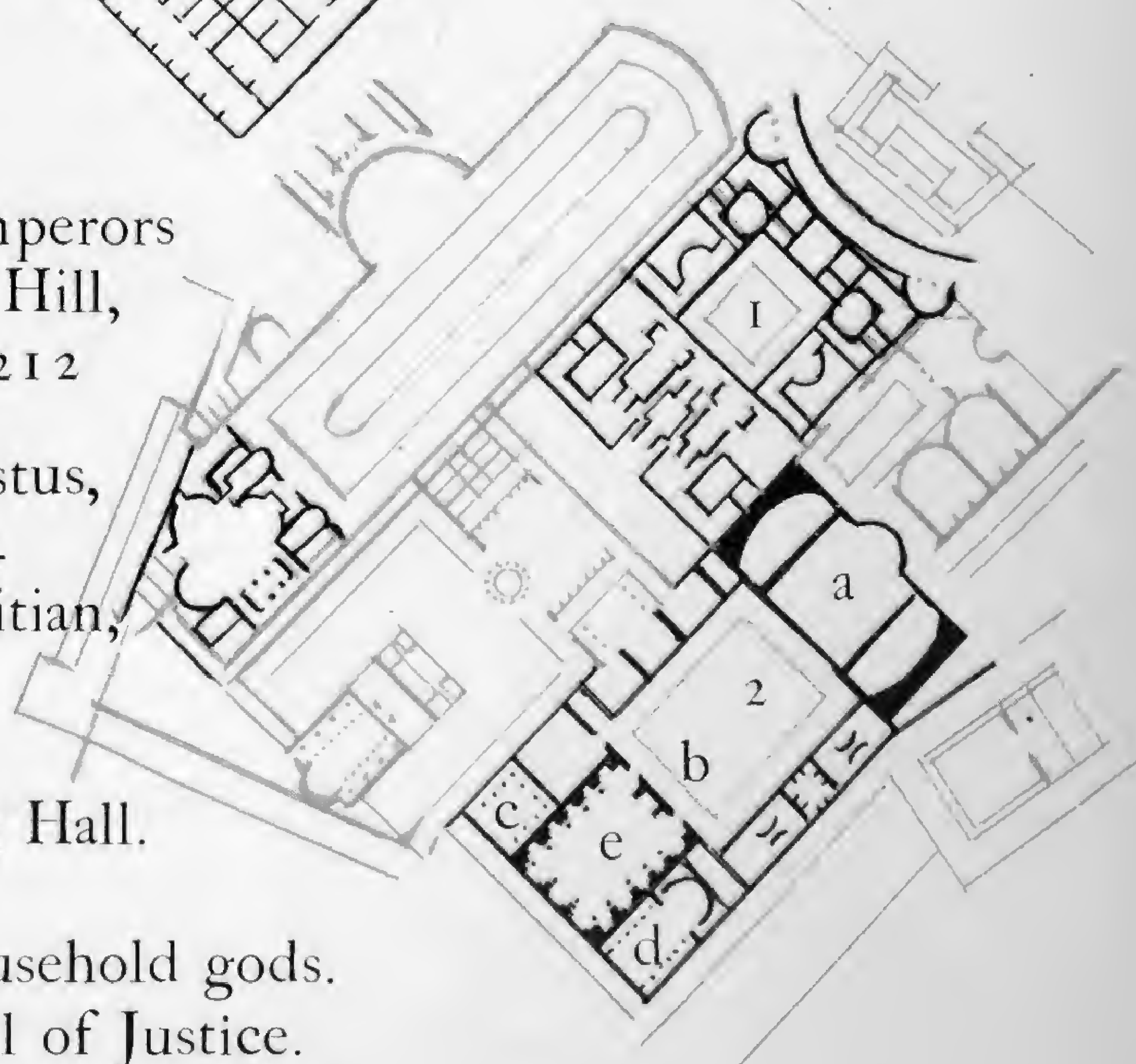


The Pantheon, Rome, A.D. 120-124

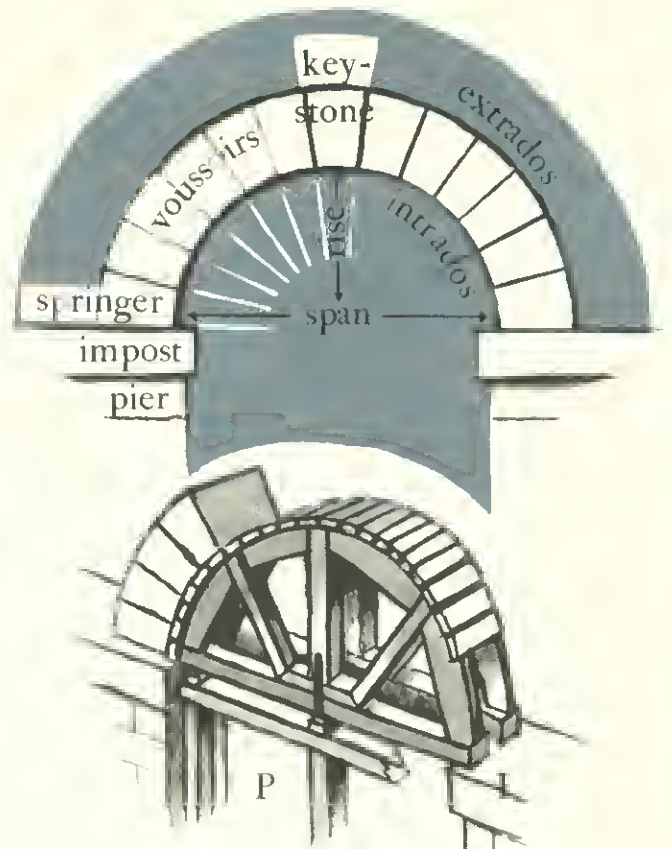


Palaces of the Emperors on the Palatine Hill, Rome, A.D. 3-212

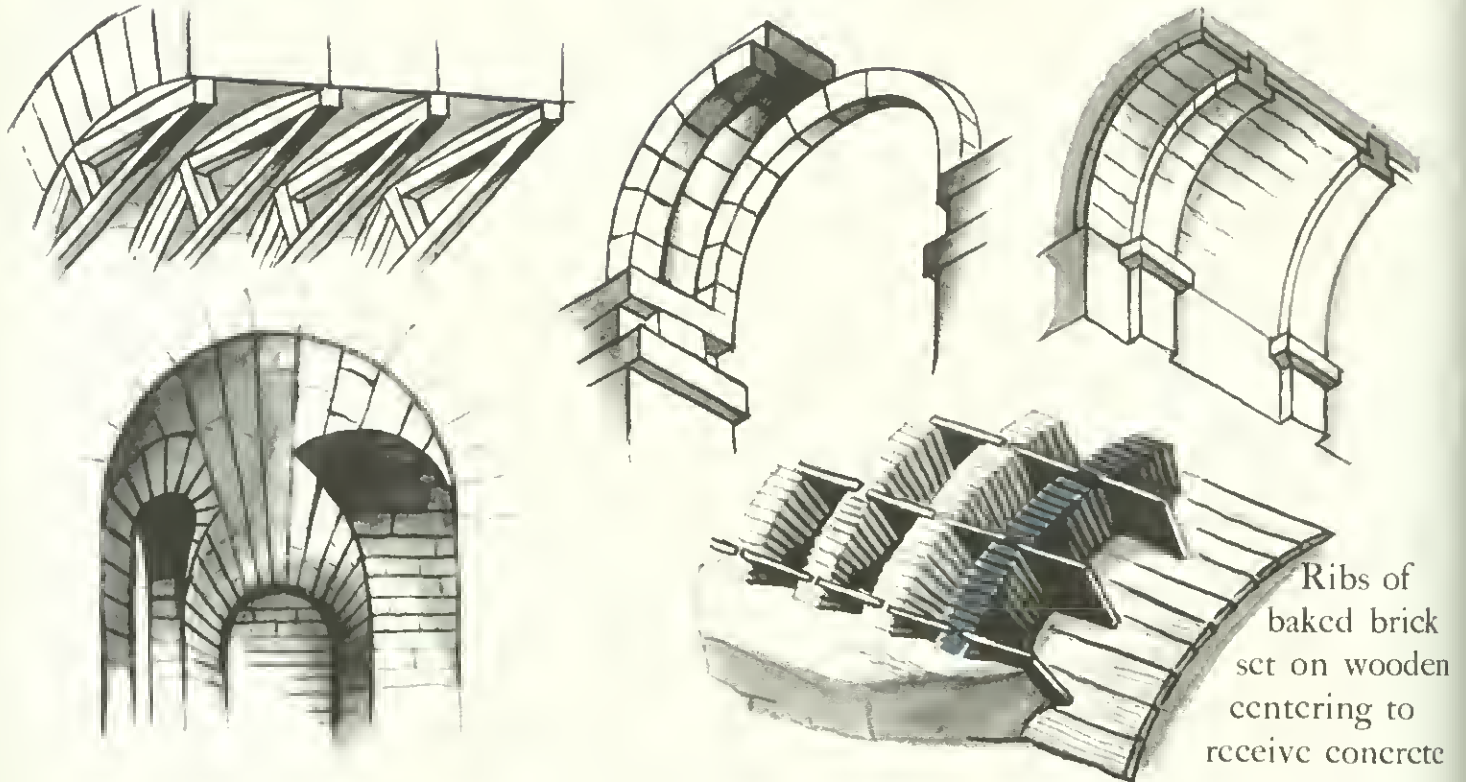
- 1 Palace of Augustus, 21 B.C.-A.D. 14
- 2 Palace of Domitian, A.D. 81-96
- a. Triclinium or Banqueting Hall.
- b. Peristyle.
- c. Temple of household gods.
- d. Basilica or Hall of Justice.
- e. Tablinum or Throne Room



ROMAN

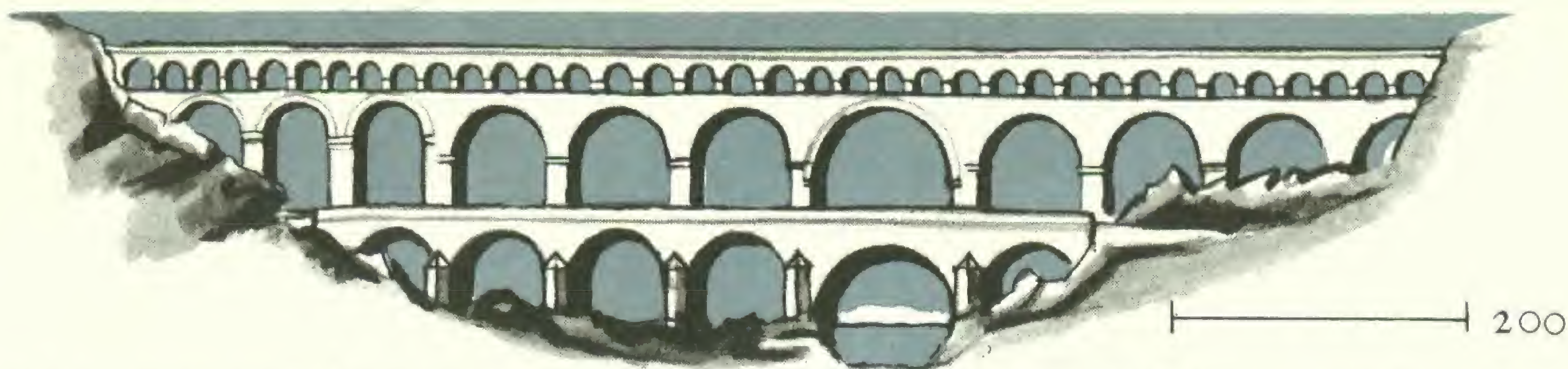


Wooden centering supported on piles P or on the impost I

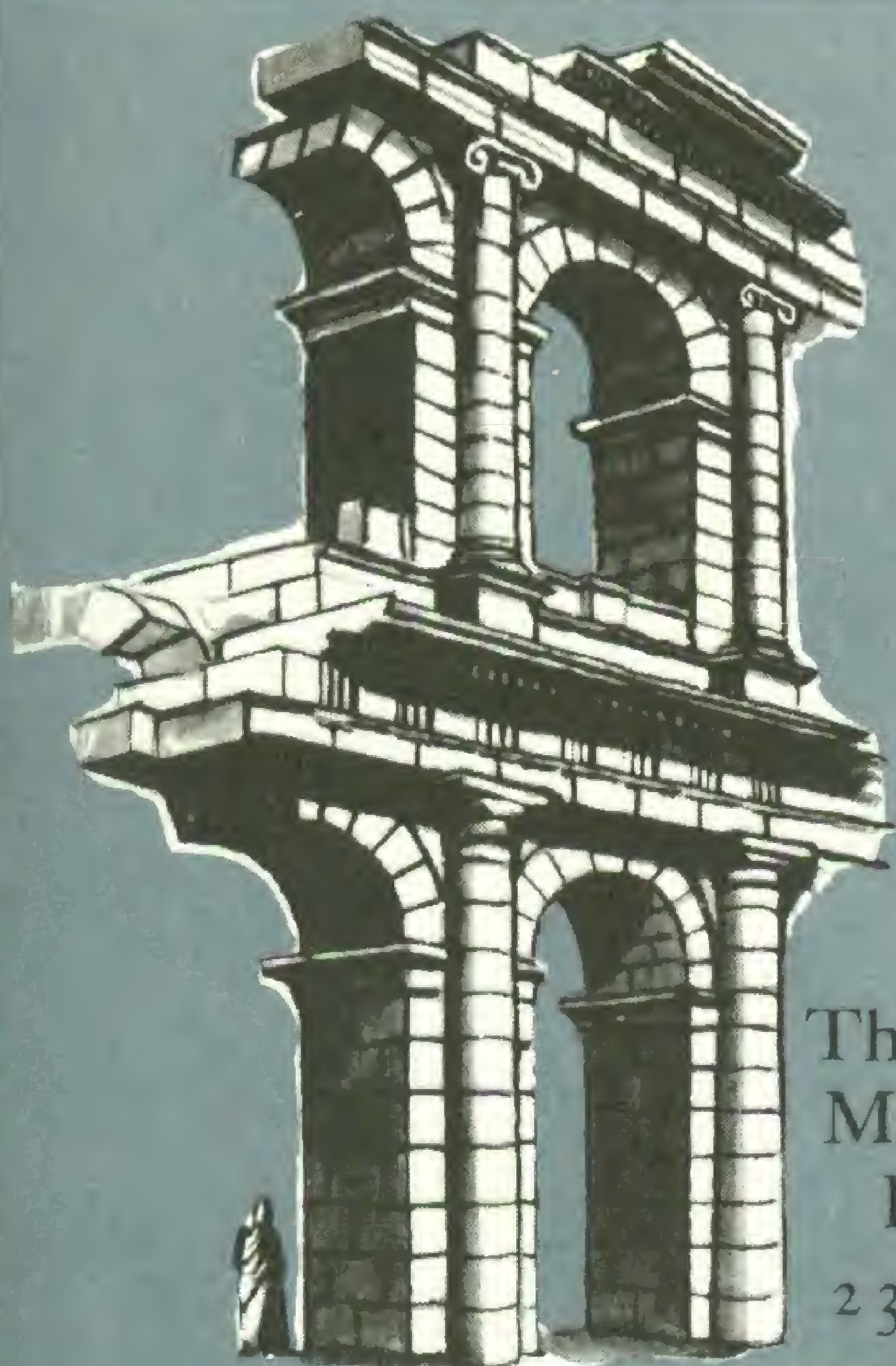


Methods of constructing stone and concrete vaults

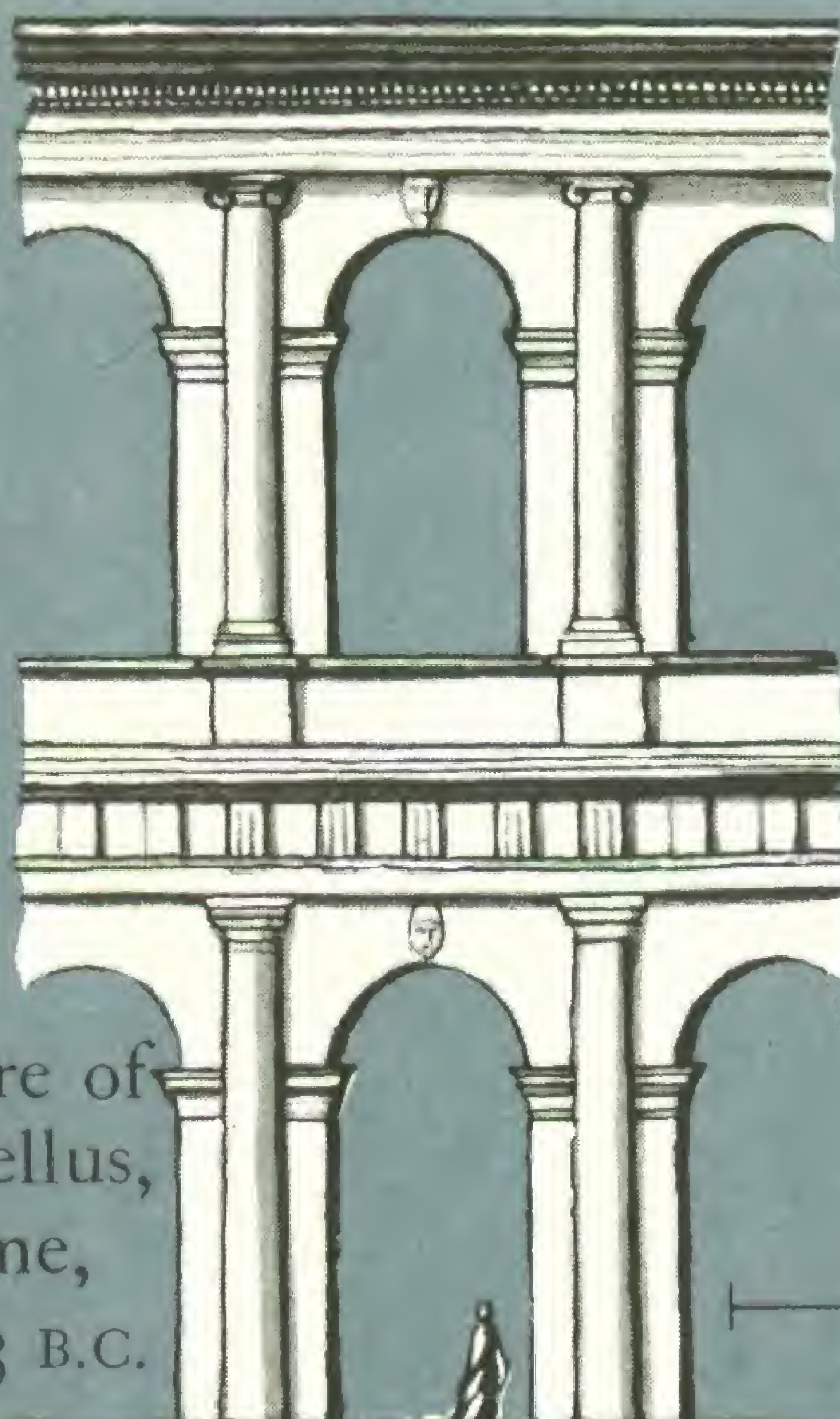
THE ARCH



Arches supported on piers: Aqueduct, Pont du Gard, Nîmes, c.A.D. 150

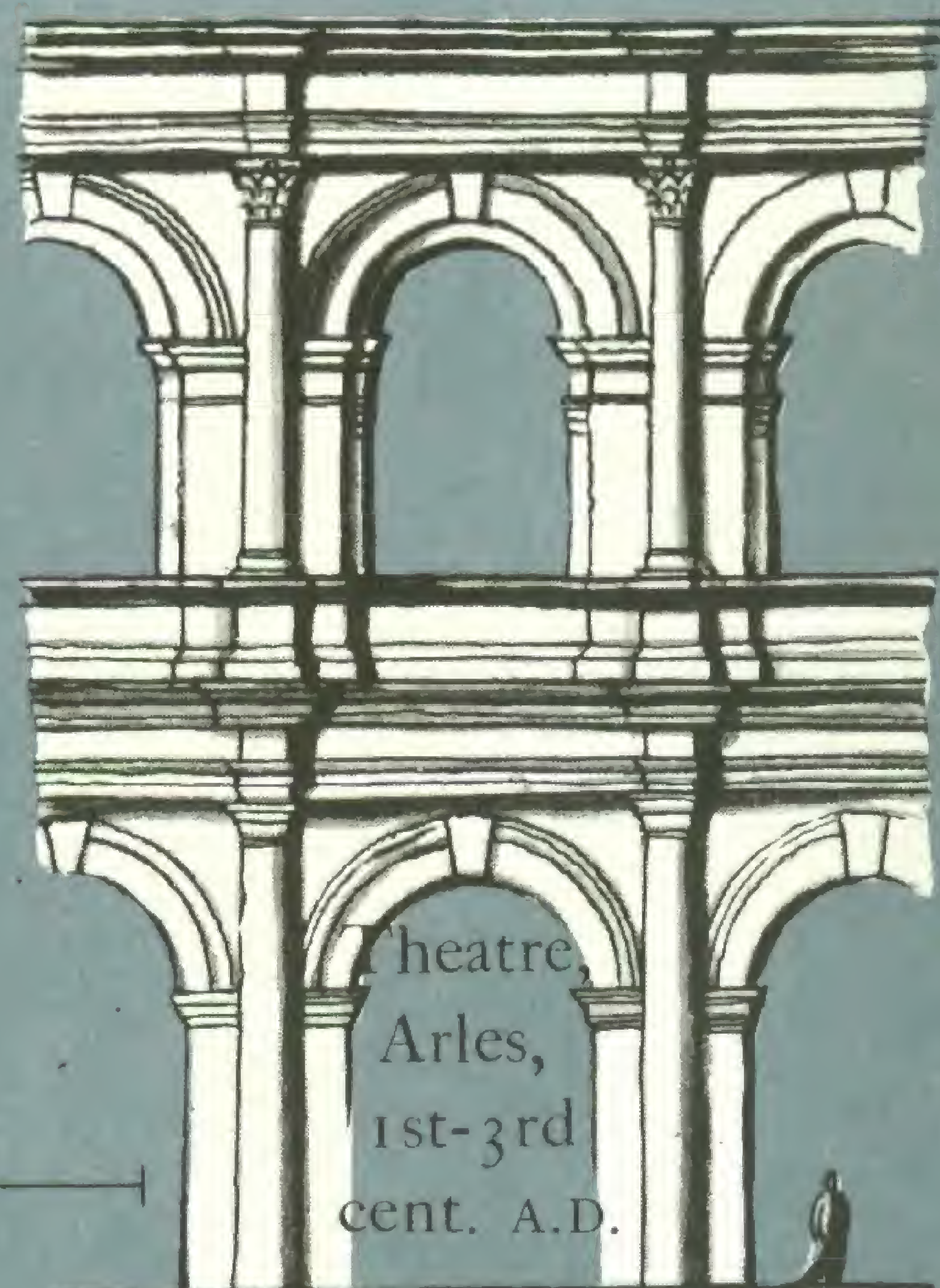


Theatre of
Marcellus,
Rome,
23-13 B.C.



20

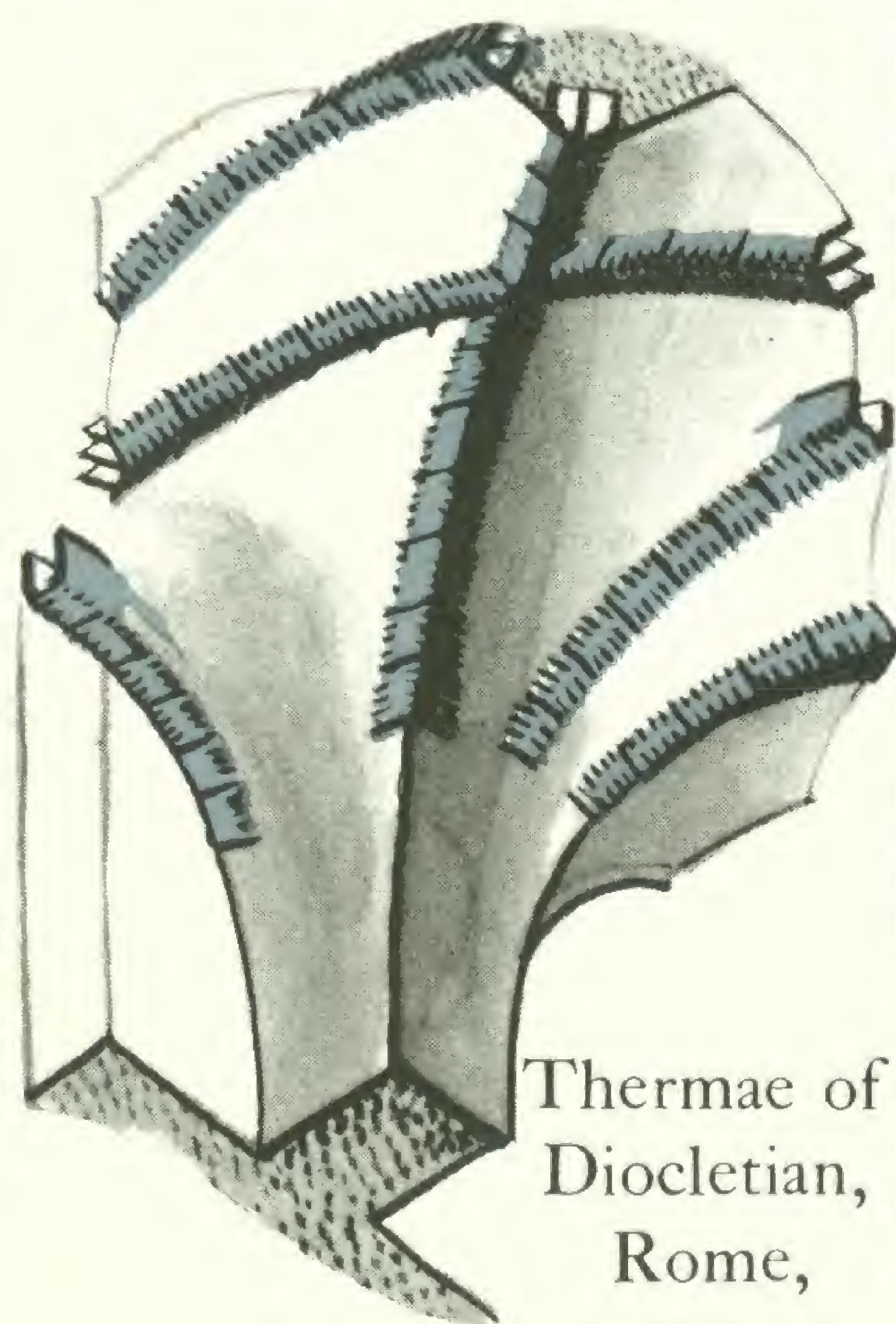
Theatre,
Arles,
1st-3rd
cent. A.D.



Construction of arches on piers with non-constructural facing of columns and entablature



The Basilica
of Constantine,
Rome, A.D. 310-13



Thermae of
Diocletian,
Rome,
A.D. 302



Arch and dome
of the Pantheon,
Rome,

50

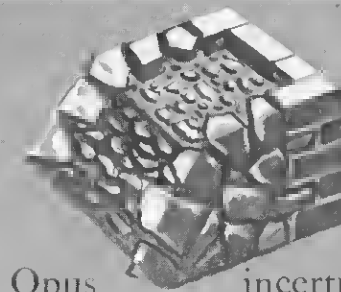
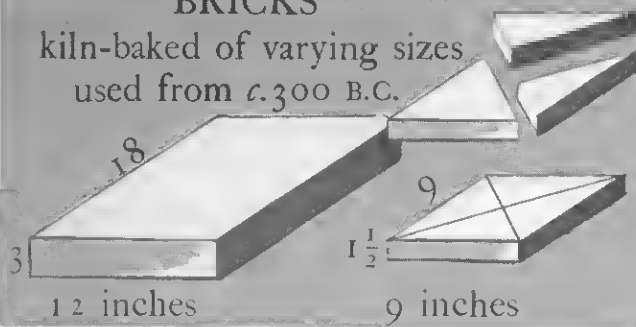
A.D. 120-24

Brick ribs in concrete cross-vaults

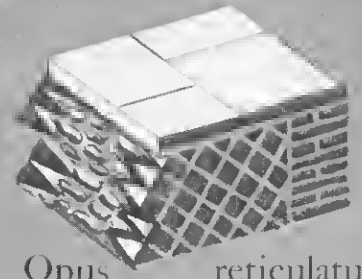
ROMAN

BRICKS

kiln-baked of varying sizes
used from c.300 B.C.



Opus incertum
from c.200 B.C.

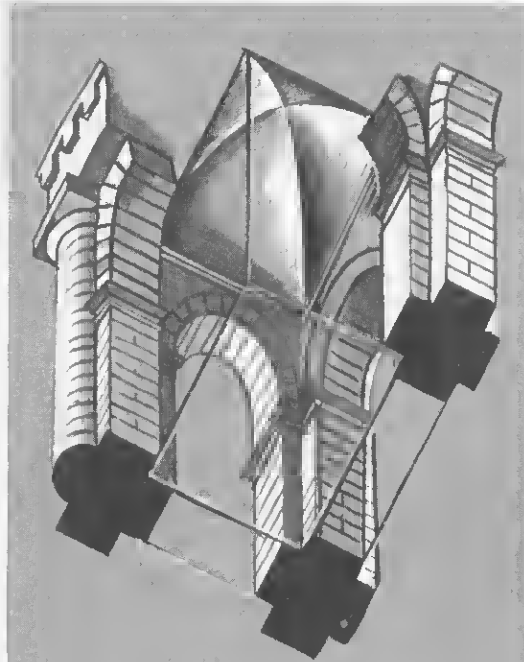


Opus reticulatum
Concrete walls faced

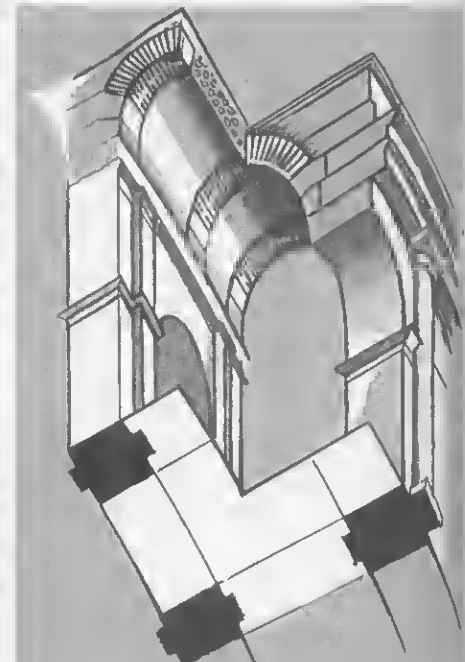
CONCRETE

used by the Romans from the 2nd century B.C., consisting of sand, gravel, pebbles, chippings of stone, mixed with a cement of lime and water and spread over a temporary wooden or permanent brick centering, to solidify into the required shape—arch, vault or dome. The dead weight rested upon supporting walls or piers without exerting an outward thrust. Pozzolana, a volcanic rock found near Rome, made a concrete of great hardness and durability.

Concrete surfaces were faced with stucco, brick or marble for protection and finish.

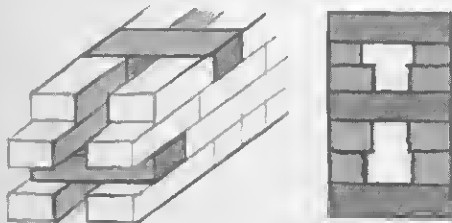


Cloister vault of concrete
supported on cruciform piers
Tabularium, Rome, 78 B.C.

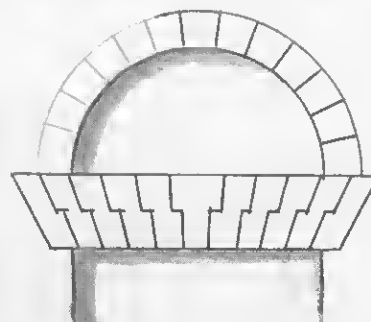
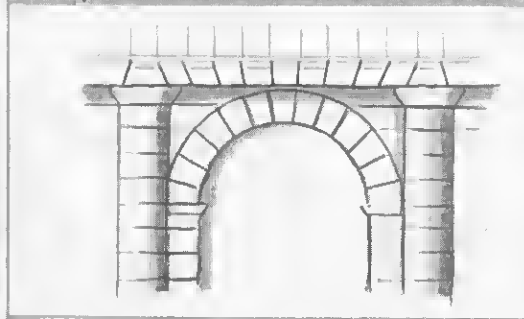


Concrete barrel vault
The Colosseum, Rome,
A.D. 70-82

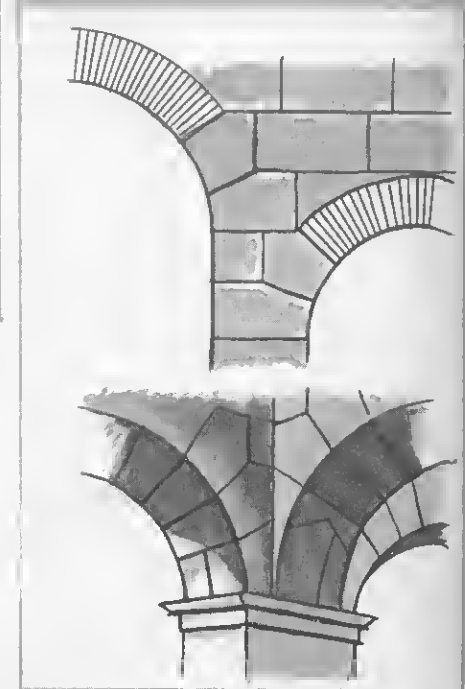
MASONRY



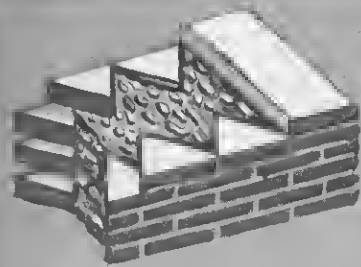
The Romans copied the Greek technique, building courses of dressed blocks, held by through stones laid dry without mortar or with iron cramps and dowels set in molten lead. The space between the courses was left empty or filled with undressed stones, earth or concrete.



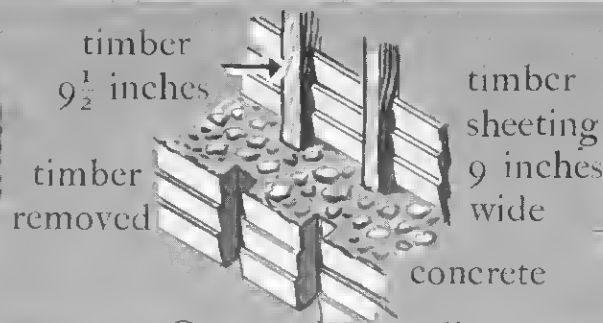
Flat arch : Orange



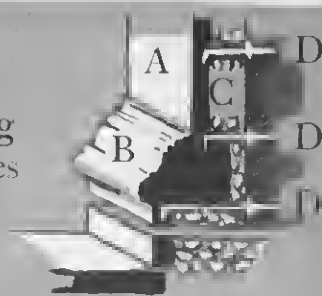
MATERIALS & METHODS



Opus testaceum
with brick from c.78 B.C.

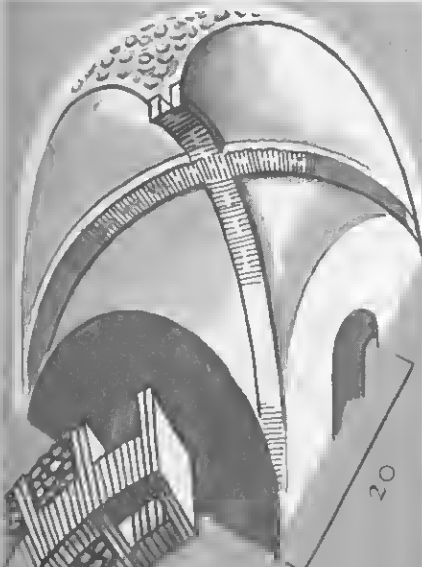


Cast concrete wall

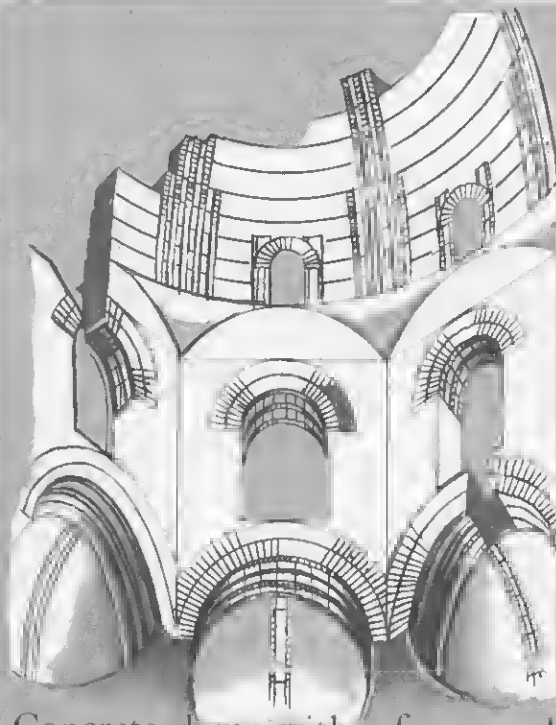


A marble slab
B plinth
C cement
D iron clamps

Method of fixing marble facing



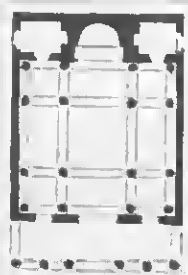
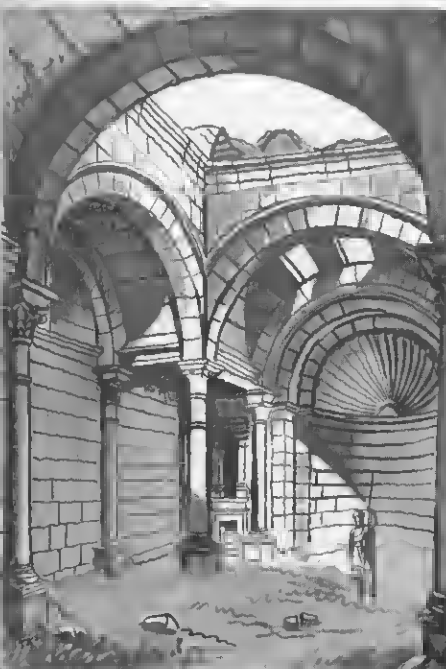
Cross-vault
built of brick ribs
and filled in with concrete
Villa Sette Bassi, near
Rome, c.A.D. 123-134



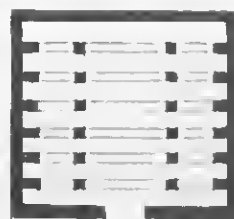
Concrete dome with a framework of
brick ribs
Temple of Minerva Medica, Rome, c.A.D. 260



brick ribs



The
Pretorium,
Musmiych,
c.A.D. 180



— 65 —

The Basilica,
Shakka,
c.A.D. 175-200

Syria:

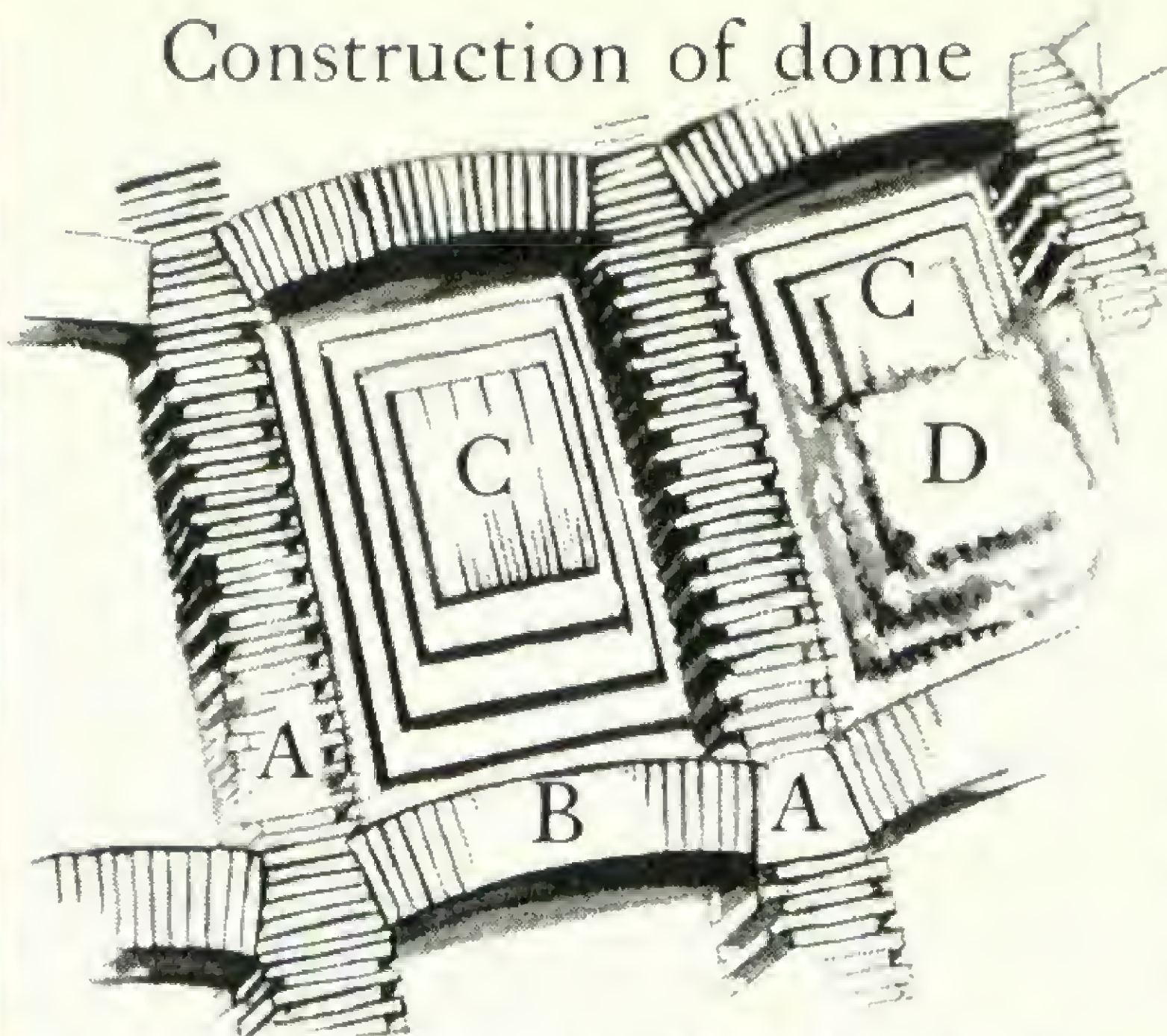
buildings of dressed stone
continued in the period of
Early Christian architecture in
the 5th to 7th centuries



ROMAN



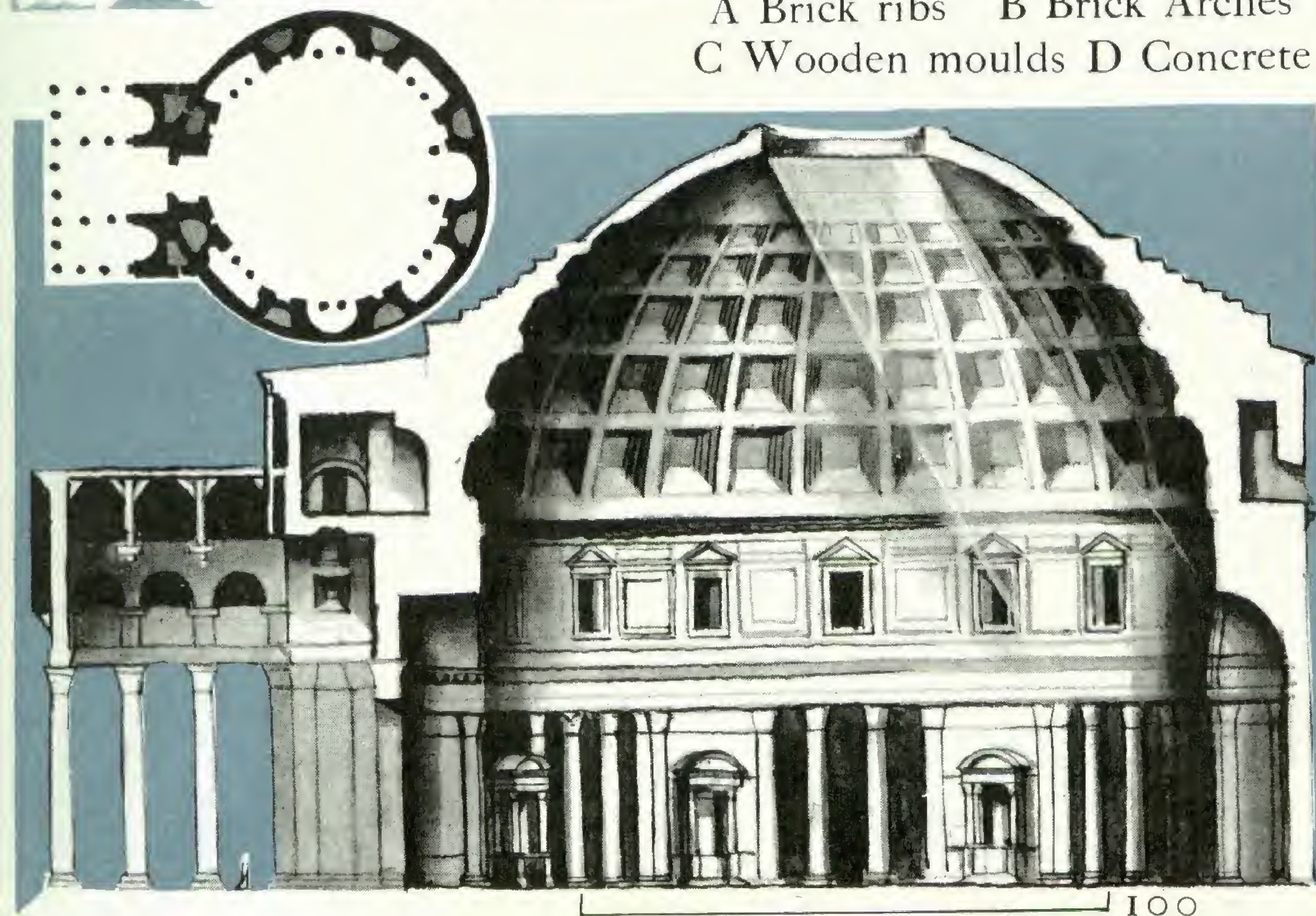
Construction of dome



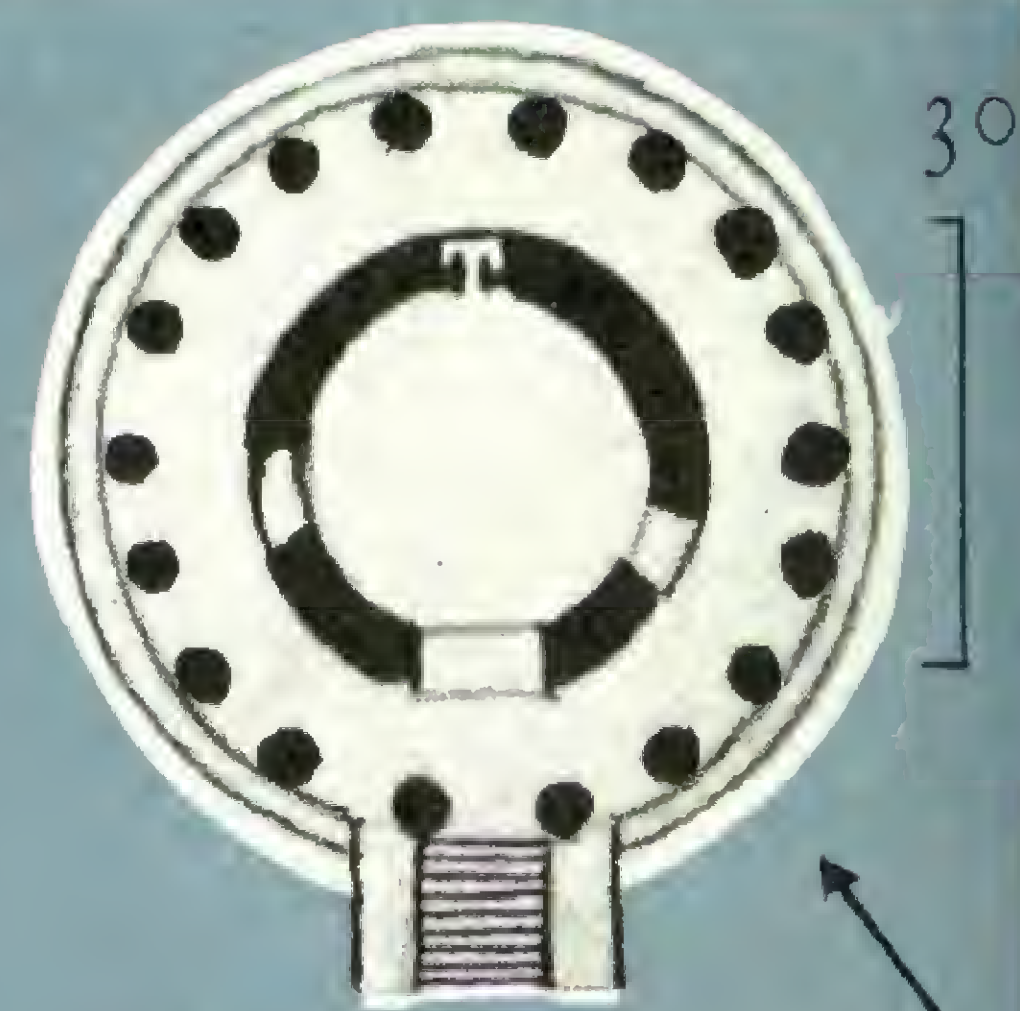
A Brick ribs B Brick Arches
C Wooden moulds D Concrete



Concealed brick arches link together 8 massive brick piers supporting the dome

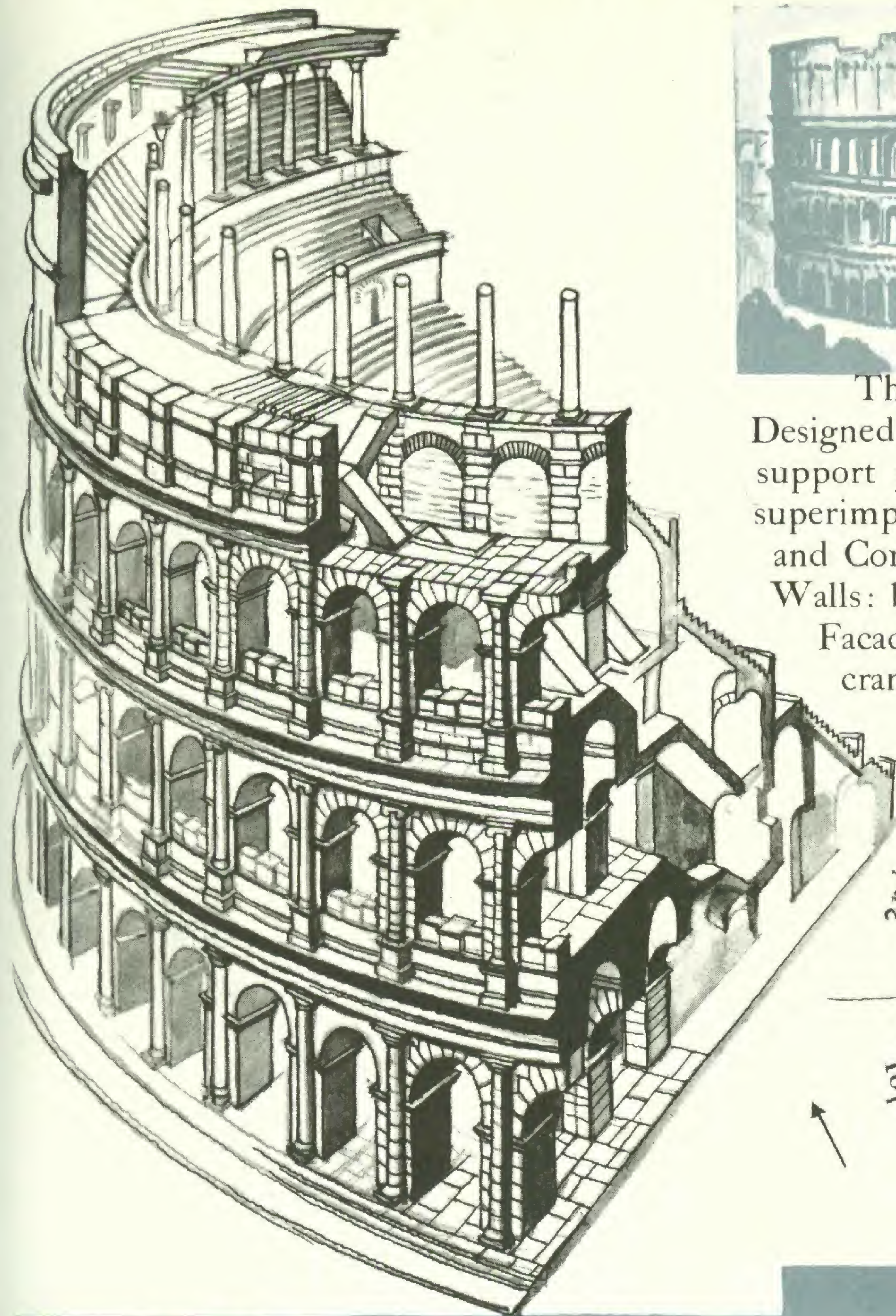


The Pantheon, Rome, A.D. 120-24. Erected by Hadrian



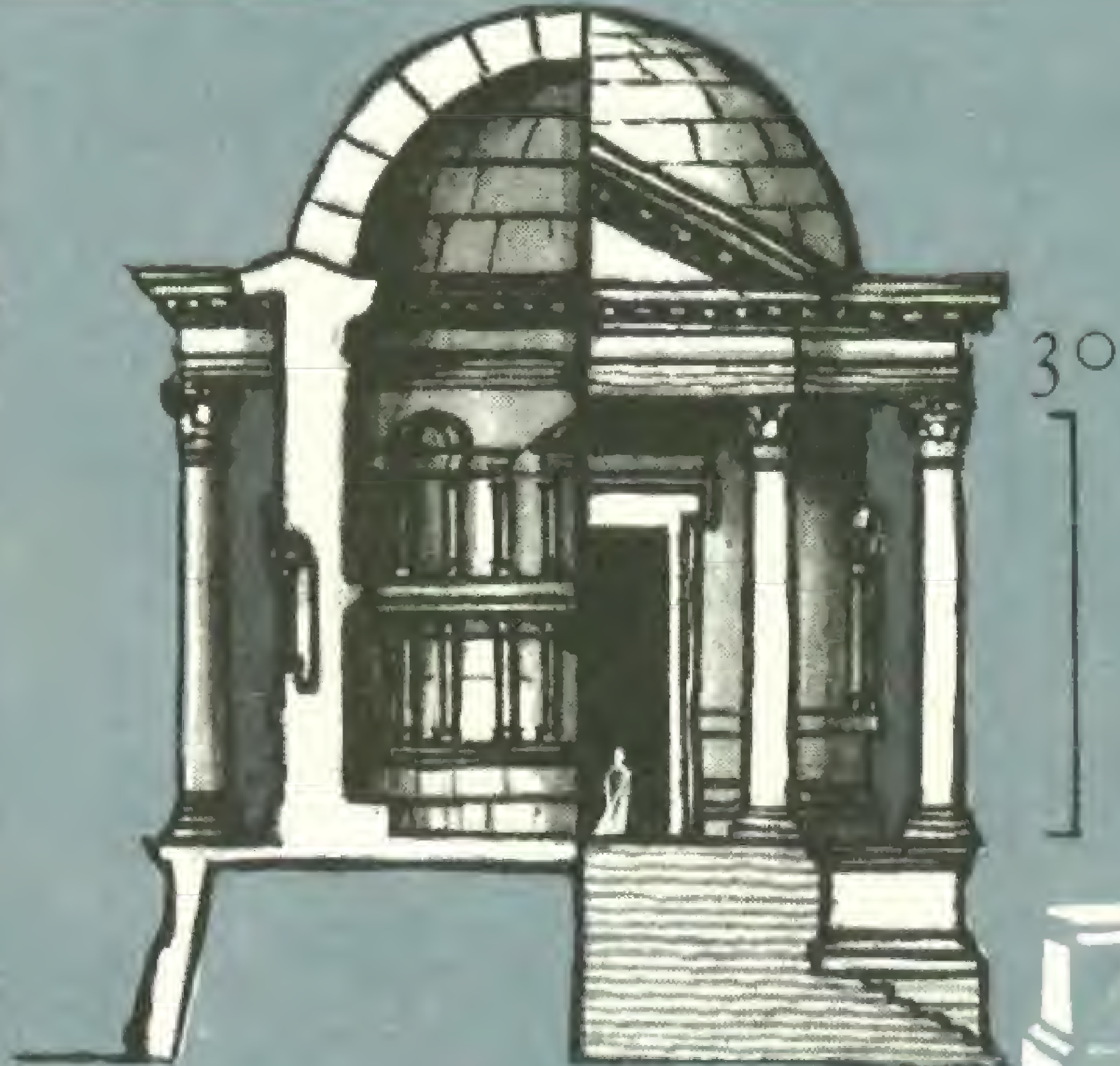
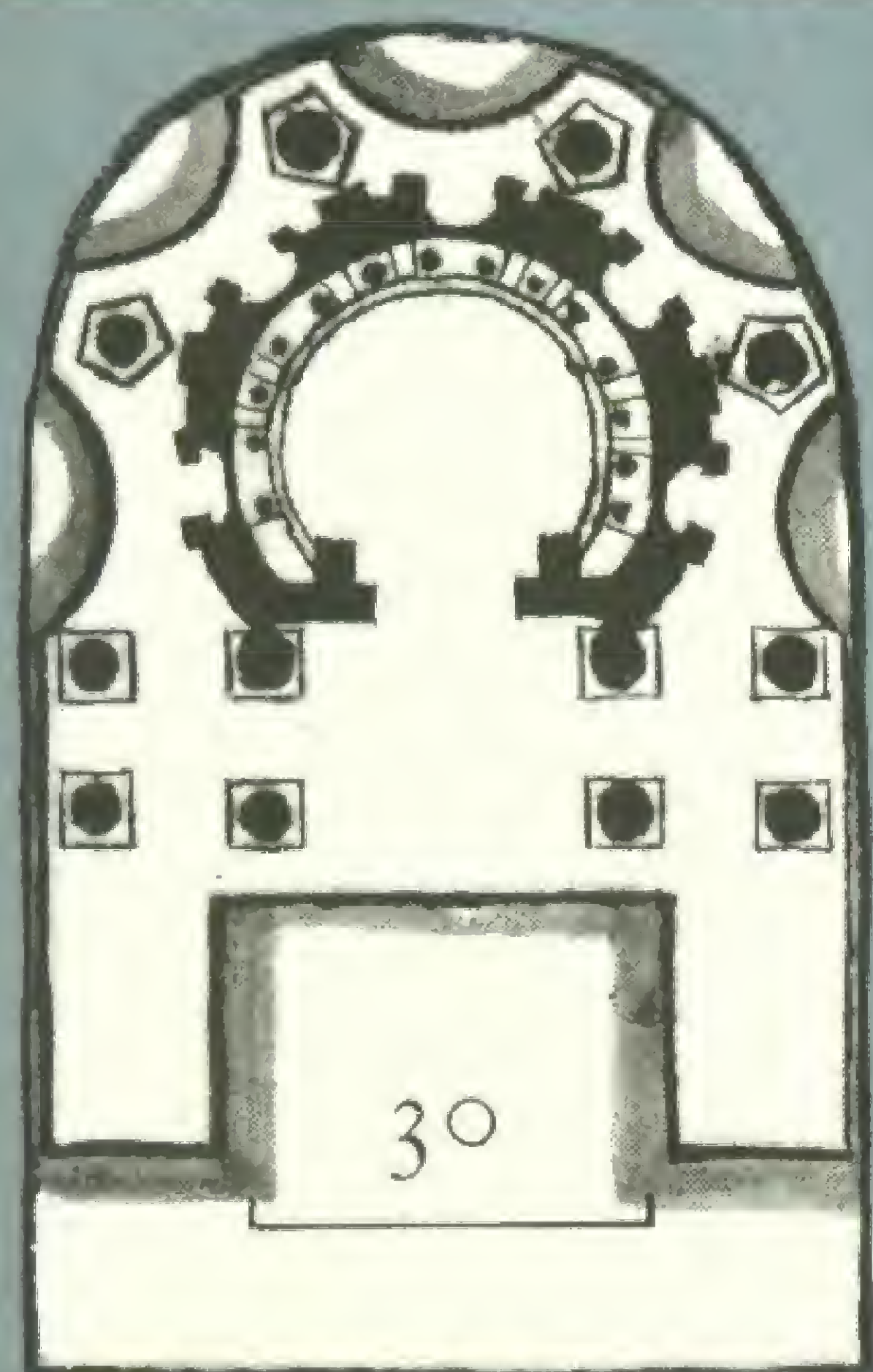
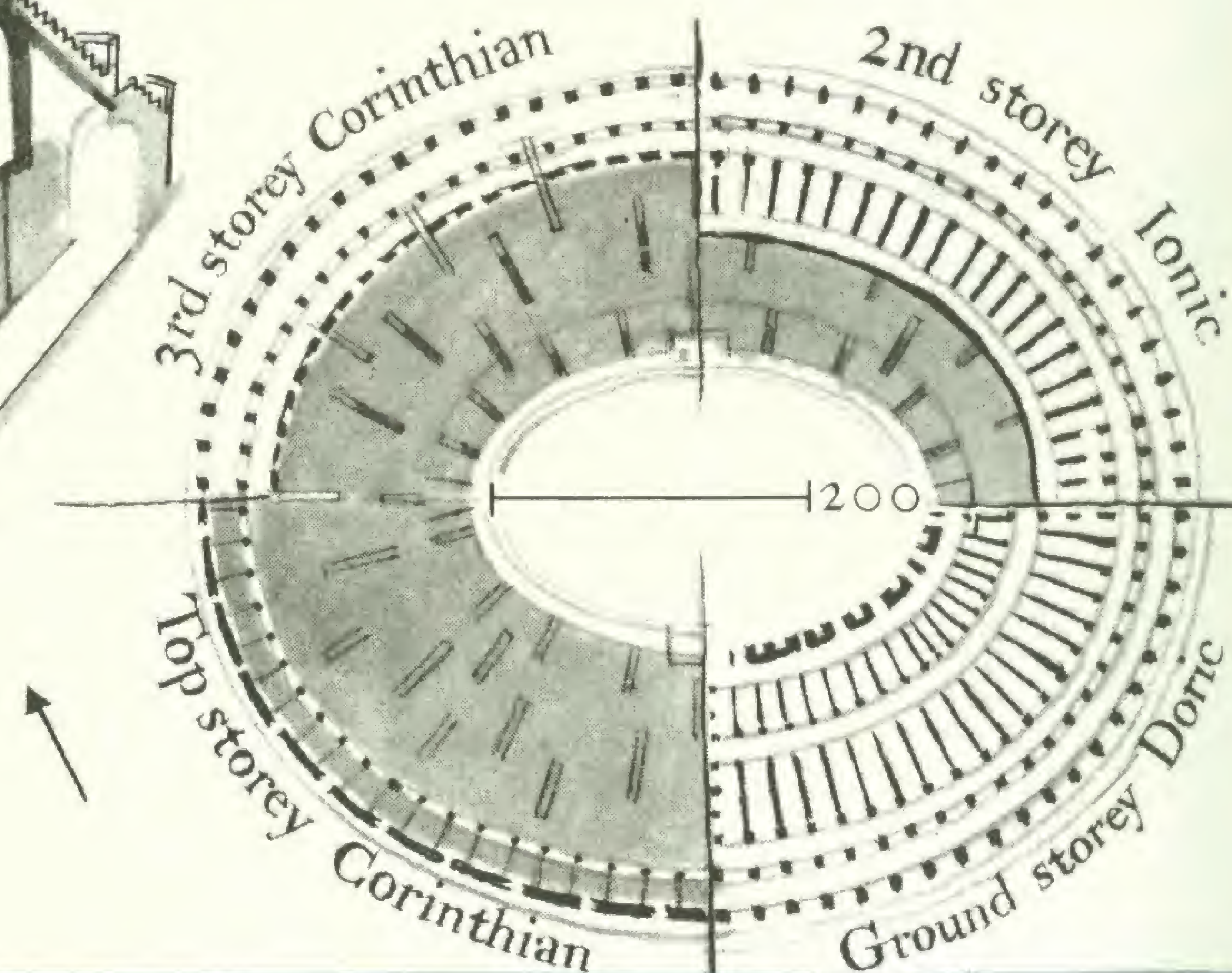
The Temple of Vesta, Tivoli (restored), 27 B.C.-A.D. 14
Foundations: tufa. Podium and walls: concrete.
Columns and door: travertine. Roof: probably a low concrete dome

CIRCULAR & OVAL BUILDINGS

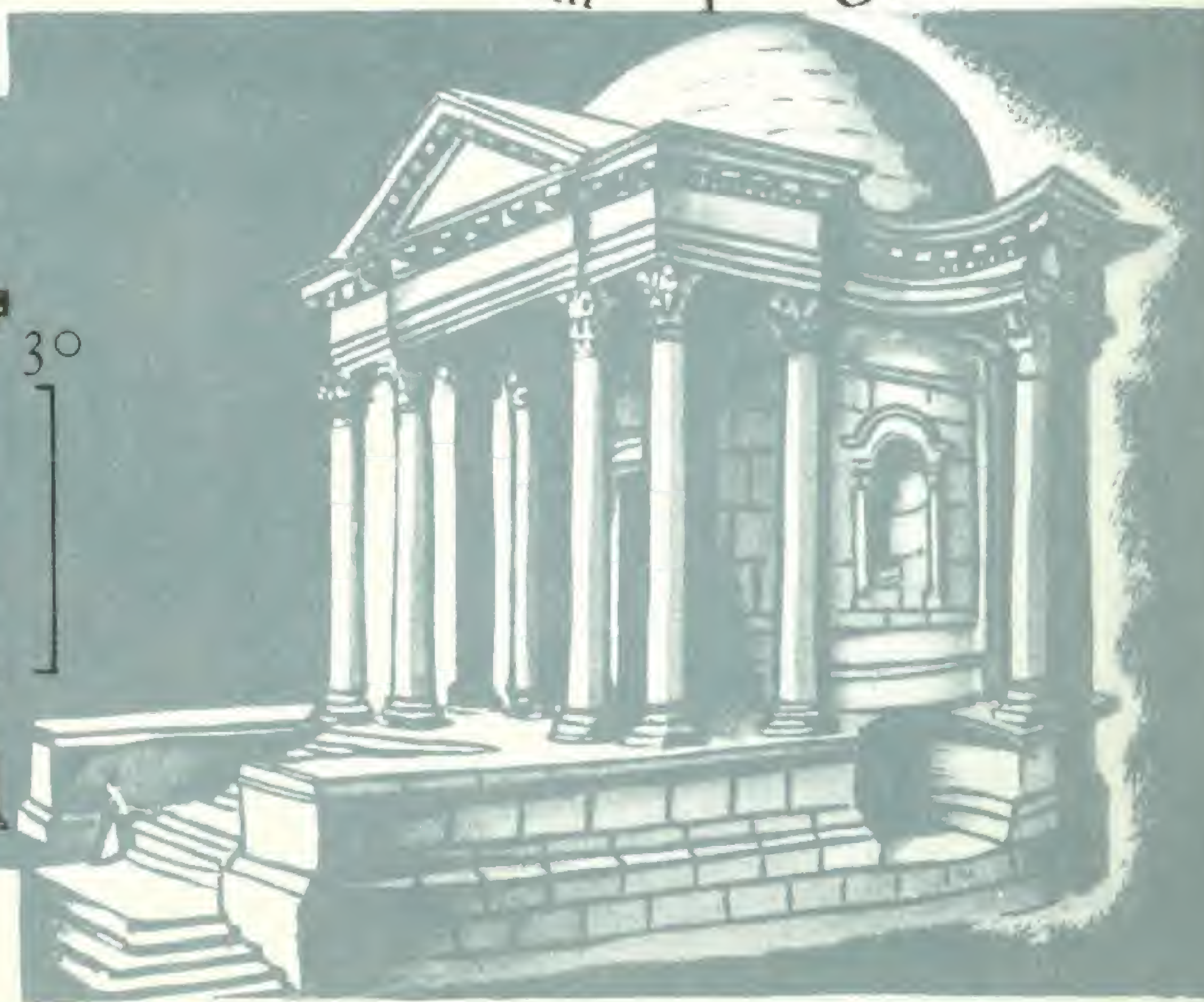


The Colosseum, Rome, A.D. 70-82

Designed for about 45,000 spectators. 80 piers support 3 tiers of arcading. Decorative use of superimposed orders of $\frac{3}{4}$ external Doric, Ionic and Corinthian columns. Foundations: lava. Walls: brick and tufa. Vaults: pumice-stone. Facade: travertine blocks held by metal cramps. Columns and seats: marble



The Temple of Venus, Baalbek (restored),
c.A.D. 245



TEMPLES

Temple of Bacchus,
c. A.D. 120-200

Temple of Jupiter,
from c. A.D. 10

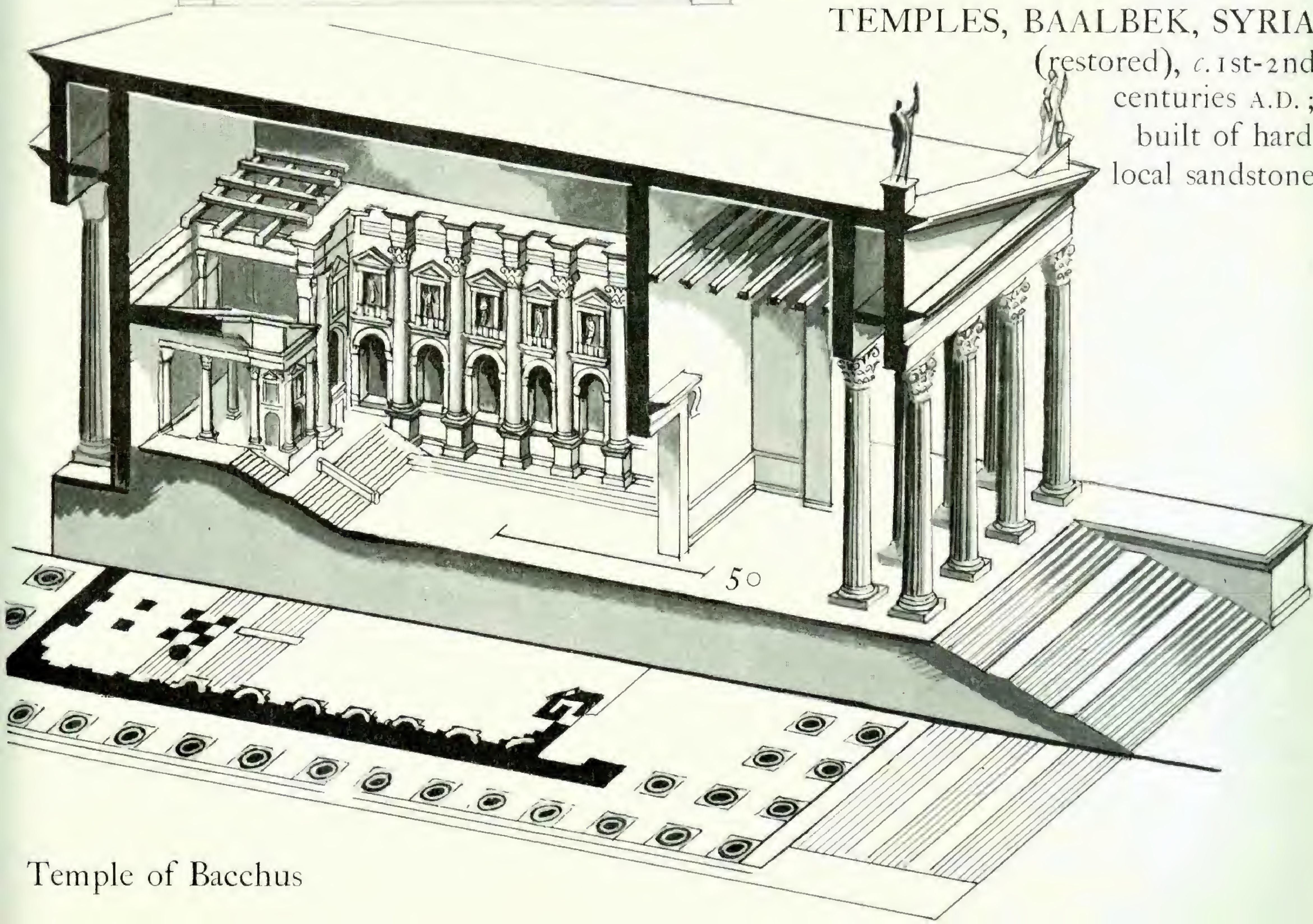
Court, c. A.D. 200

34°



Temple of Bacchus: interior

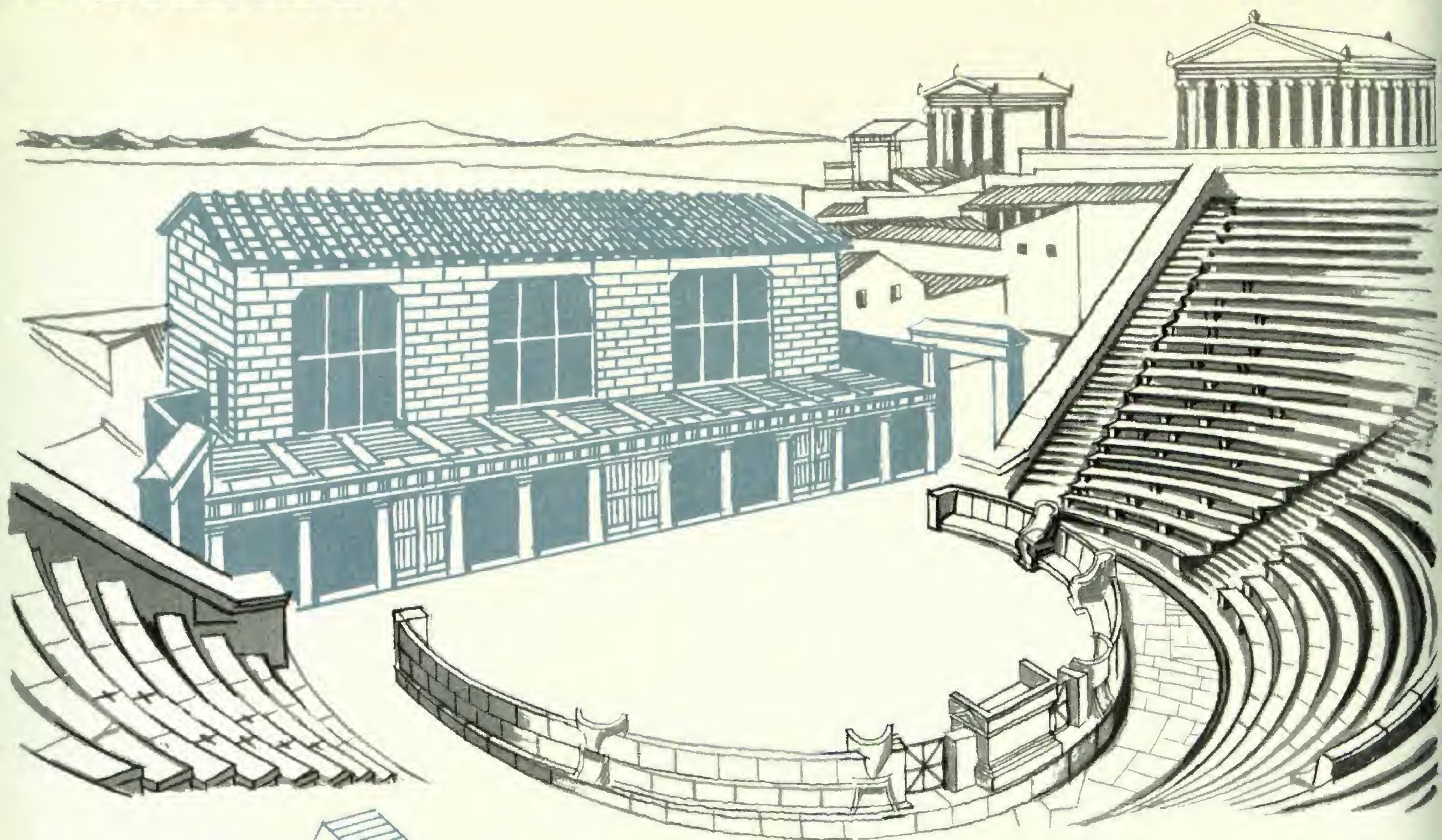
TEMPLES, BAALBEK, SYRIA
(restored), c. 1st-2nd
centuries A.D.;
built of hard
local sandstone



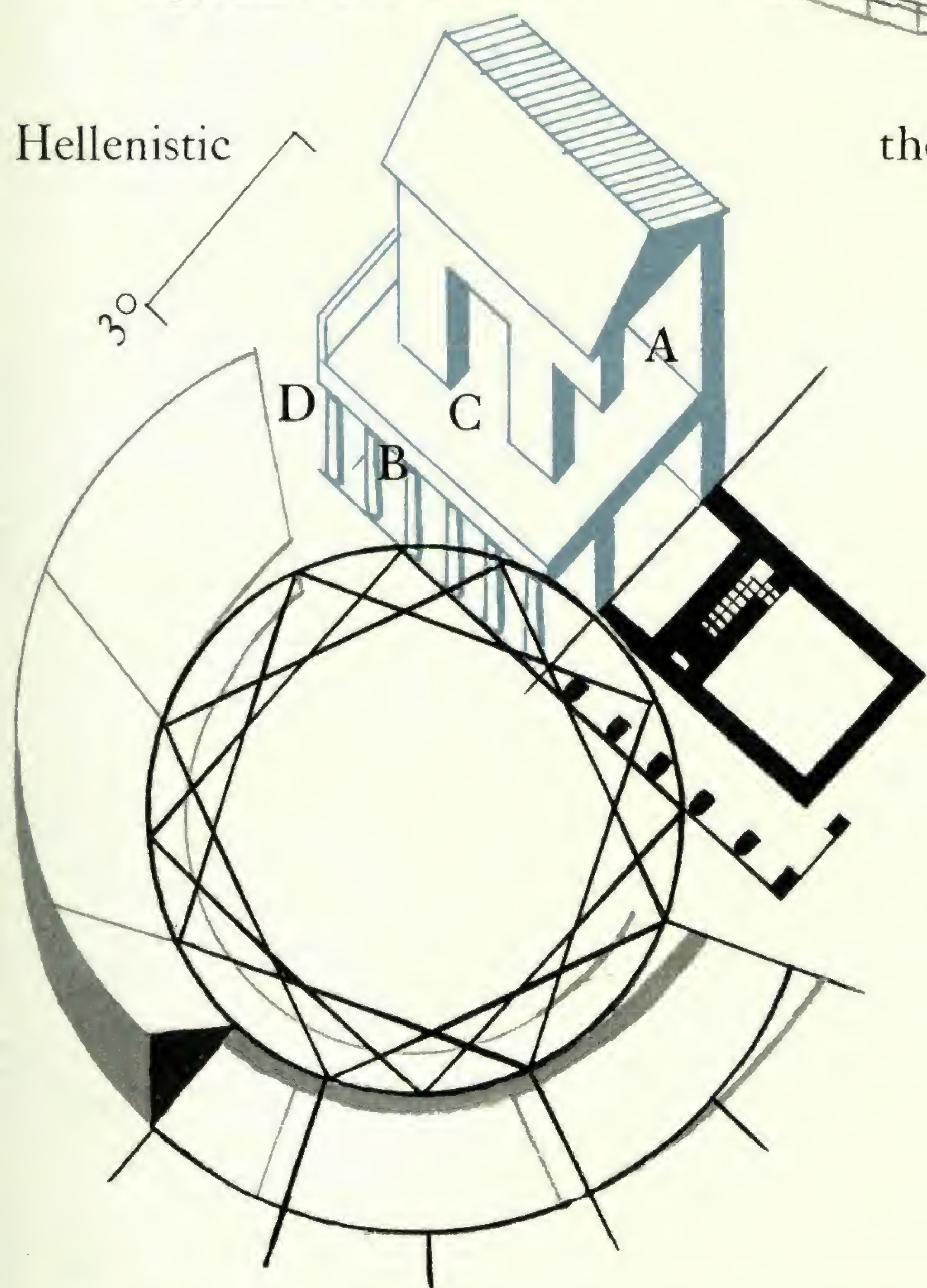
Temple of Bacchus

GREEK

THEATRE



Hellenistic



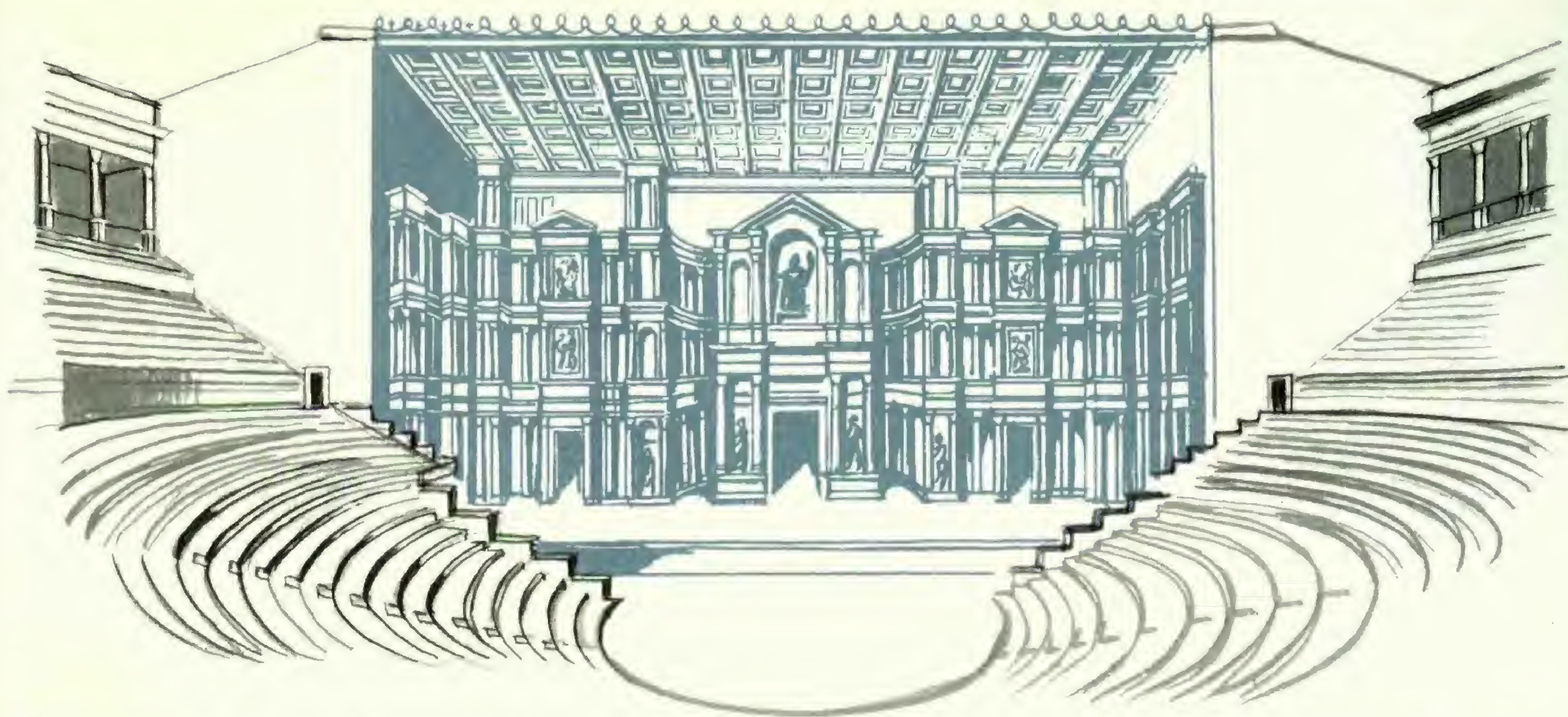
theatre, Priene, Asia Minor (restored), c.50 B.C.

The early Greek theatre consisted of an auditorium (simply a hill slope with stone seats), a semi-circular orchestra where the chorus sang and danced, and a wooden stage from which a single actor would hold a dialogue with the chorus. The number of actors was raised to two or three by Aeschylus (525-456 B.C.) and Sophocles (495-406 B.C.), who also introduced painted scenery and a dressing hut or skene. In the 4th century B.C. a wooden skene A was erected with a proscenium B having a row of columns, usually Doric, 8-12 ft from the skene wall supporting a stage of planks called the logeion or speaking-place C. Three doors in the skene wall were for entrances and exits of actors. At the two ends of the proscenium were the parodoi or open passage-ways D.

Plan of a Greek theatre based on 3 squares within the orchestra circle (Vitruvius, v.7)

ROMAN

THEATRE



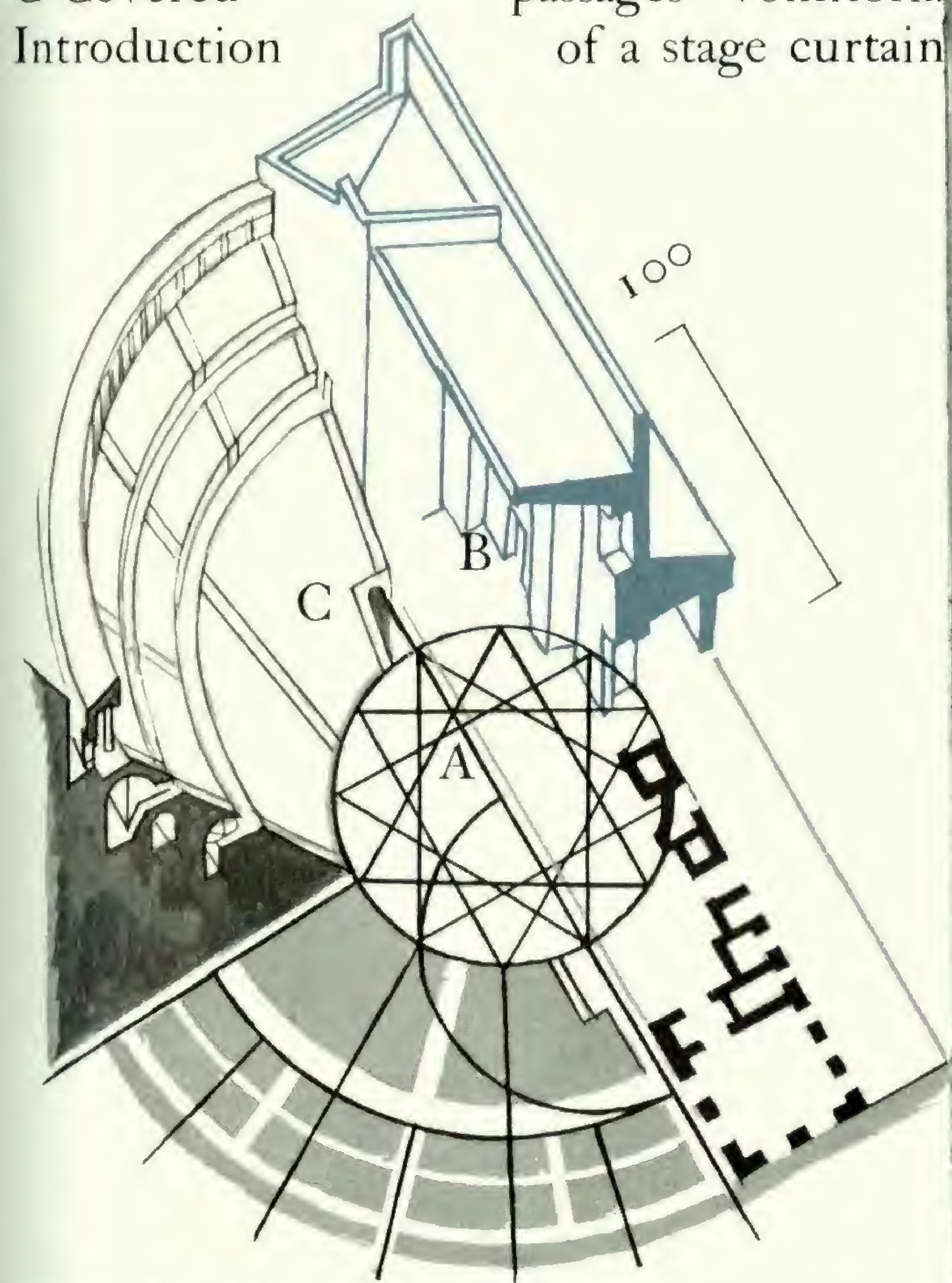
The Theatre, Orange (restored), c.A.D.50. Designed to seat 7000. Stage 5 ft high, 23 ft deep.

Built up on stone and concrete piers.

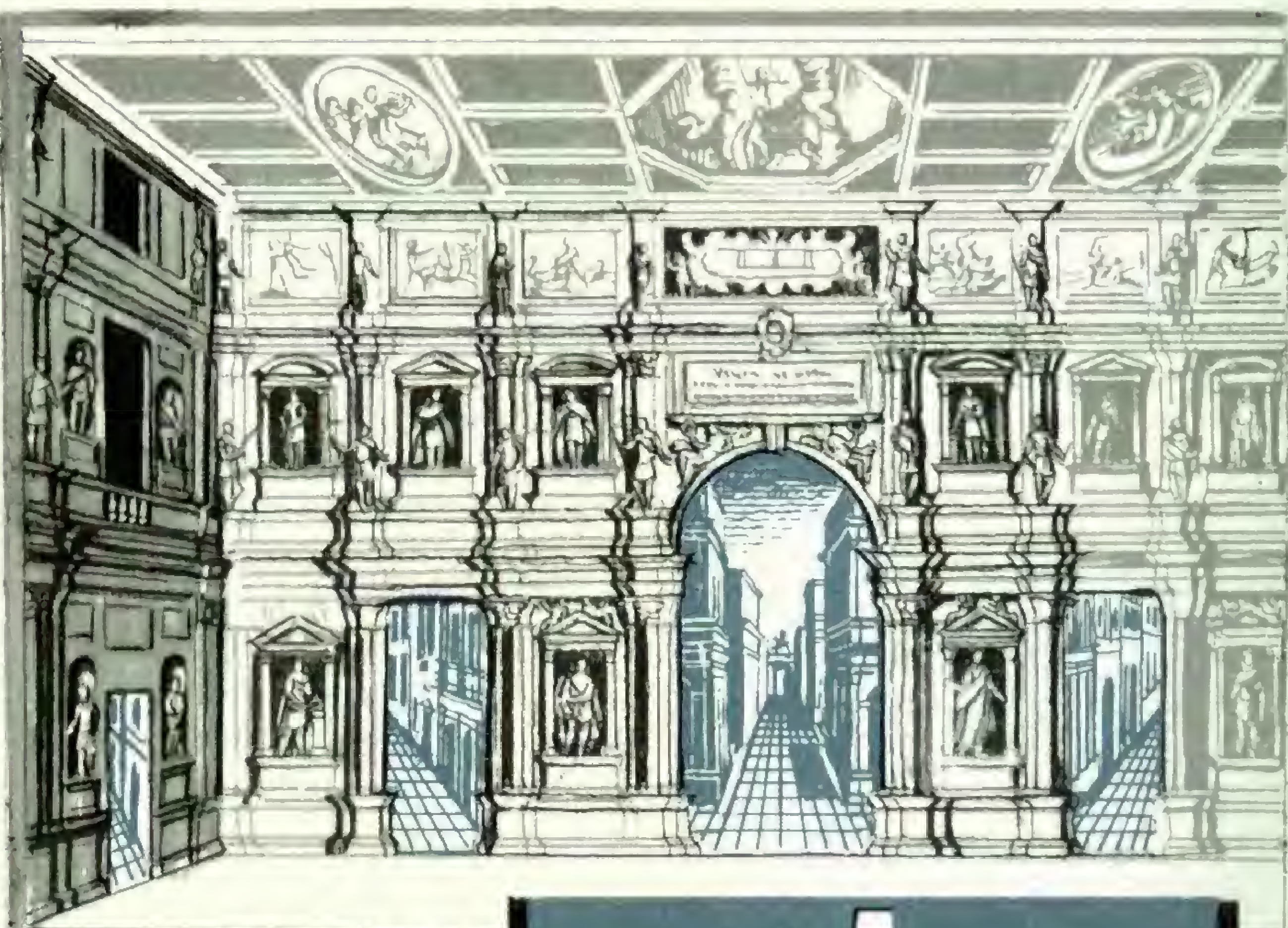
A Semi-circular cavea or auditorium

B Proscenium replaced by a frons scaenae

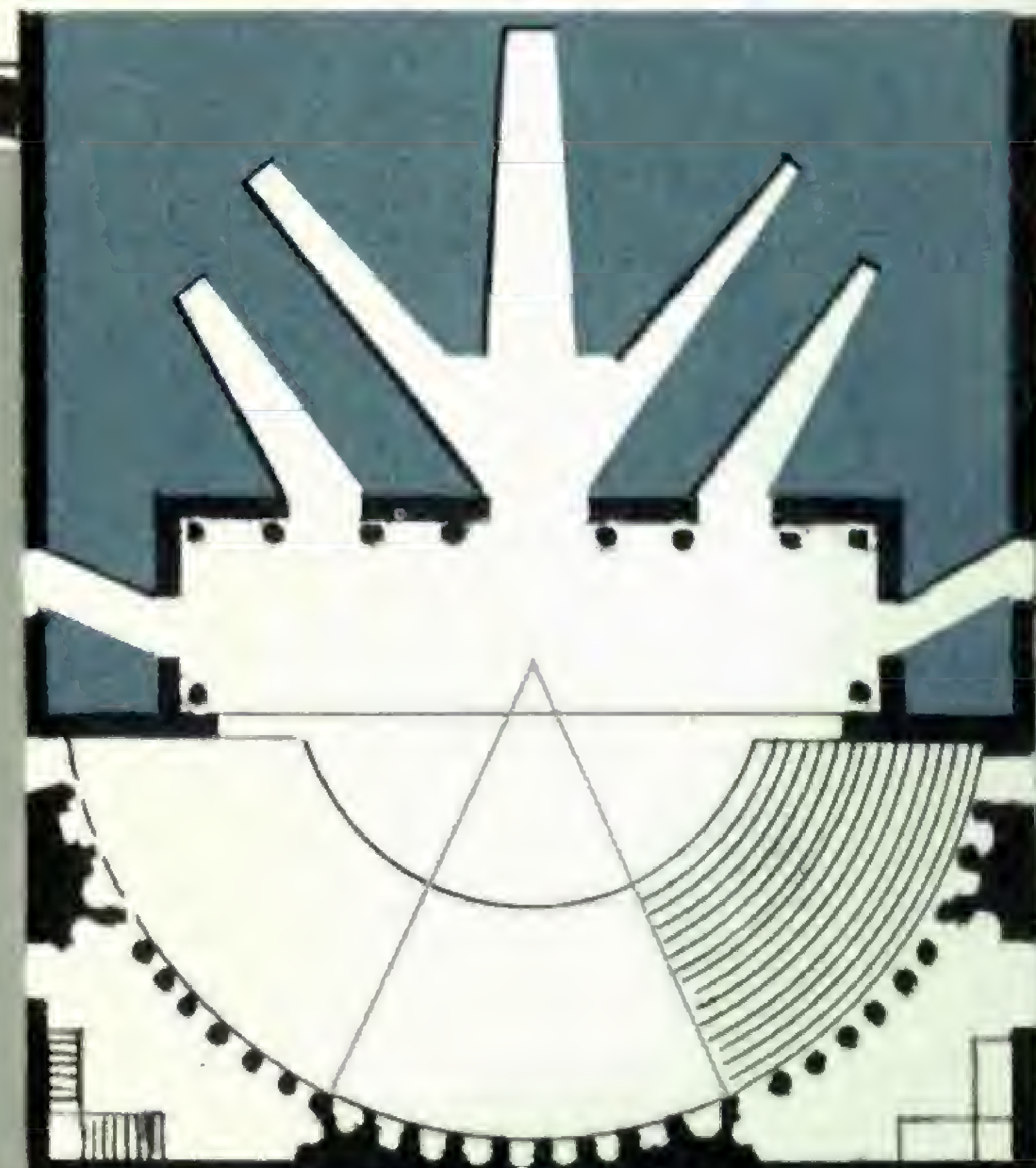
C Covered passages—vomitoria
Introduction of a stage curtain



Plan of a Roman theatre based on 4 equilateral triangles in a circle (Vitruvius v,6)



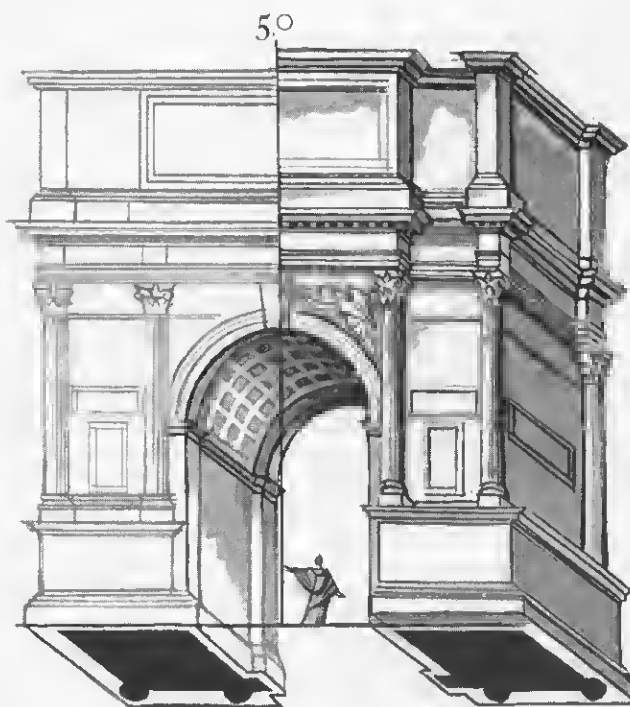
A Renaissance adaptation of a Roman theatre. The Teatro Olimpico, Vicenza, Italy, designed by Palladio and completed by Scamozzi, A.D. 1584



ROMAN



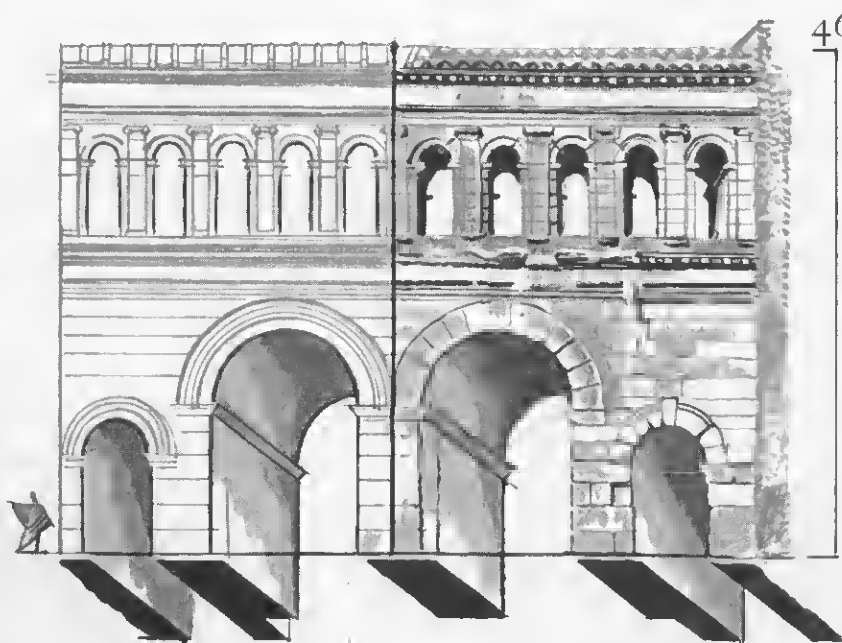
Arch of Augustus, Susa,
Piedmont, c. A.D. 8



Arch of Titus, Rome, A.D. 70
Earliest use of the Composite order.



Tomb of the Julii,
Provence, S. Remy,
c. 30 B.C.-A.D. 14

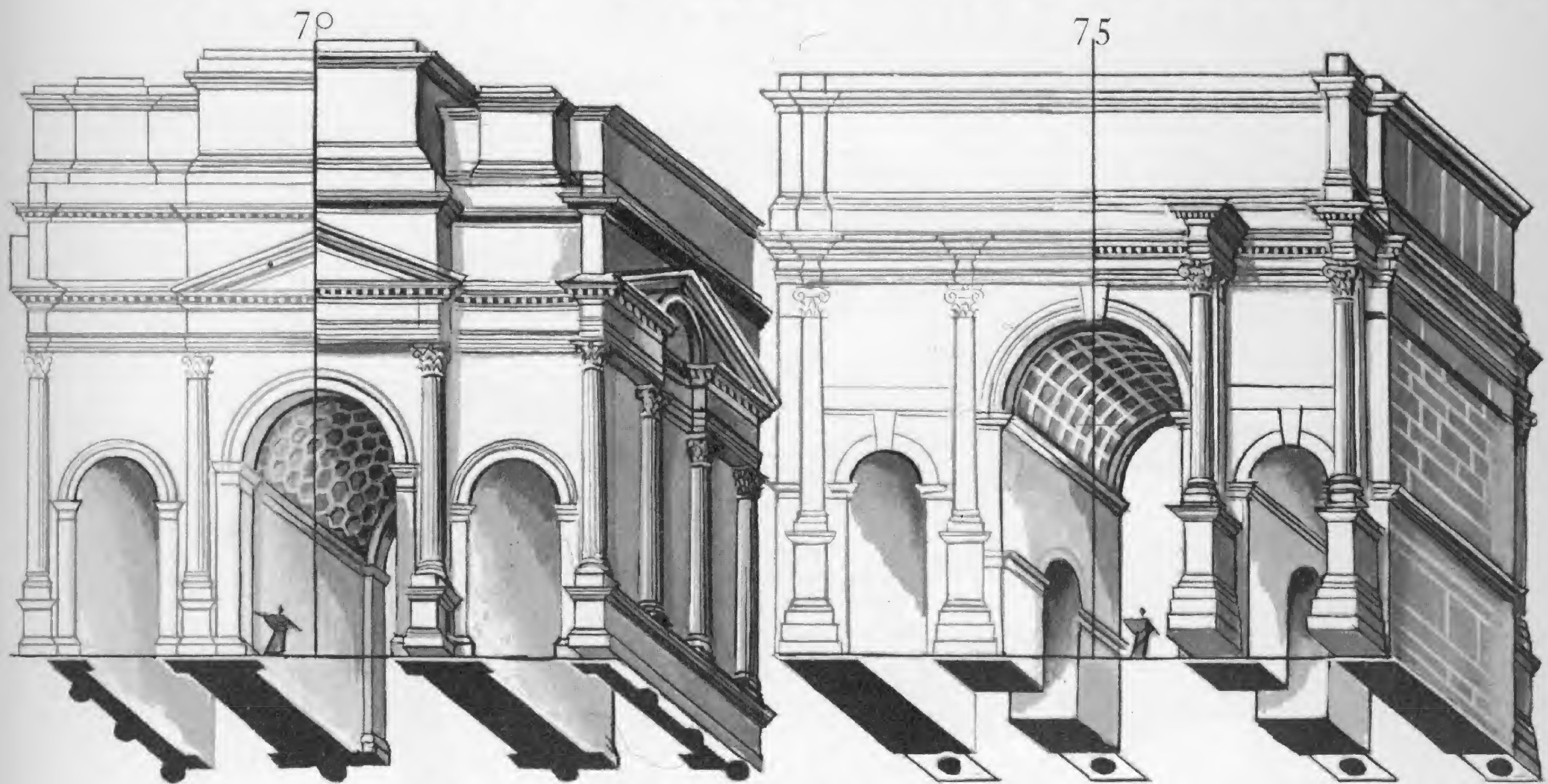


Town gateway with four archways
The Porte S. André, Augustodunum (Autun).
An arcaded gallery with Ionic pilasters creates
an antiphonal response with the rise and fall
of the large and small arches below



Trajan's
Column,
Rome,
A.D. 114.

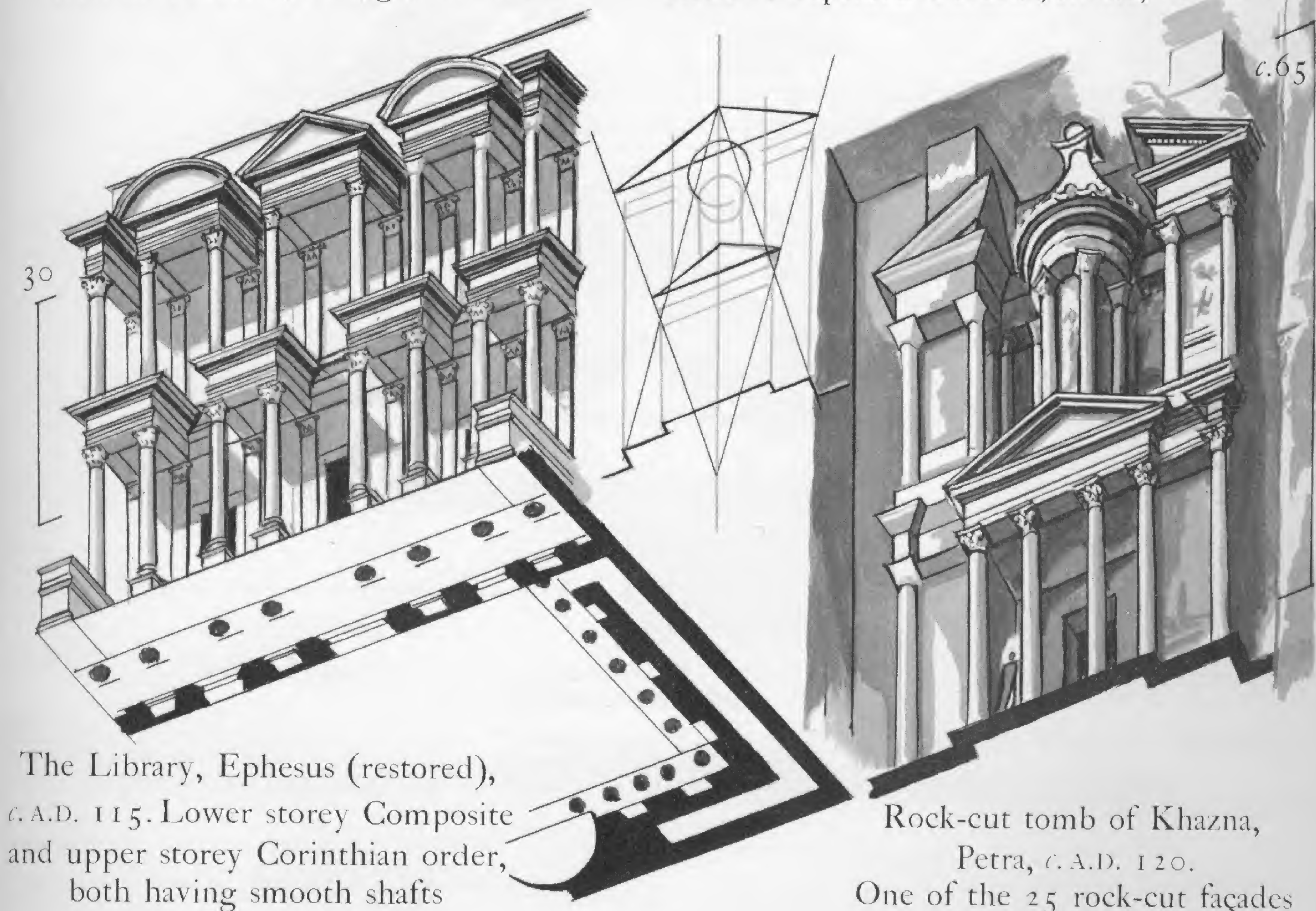
ARCHES AND MONUMENTS



Triumphal Arches with three openings.

Arch of Tiberius, Orange, c. A.D. 21

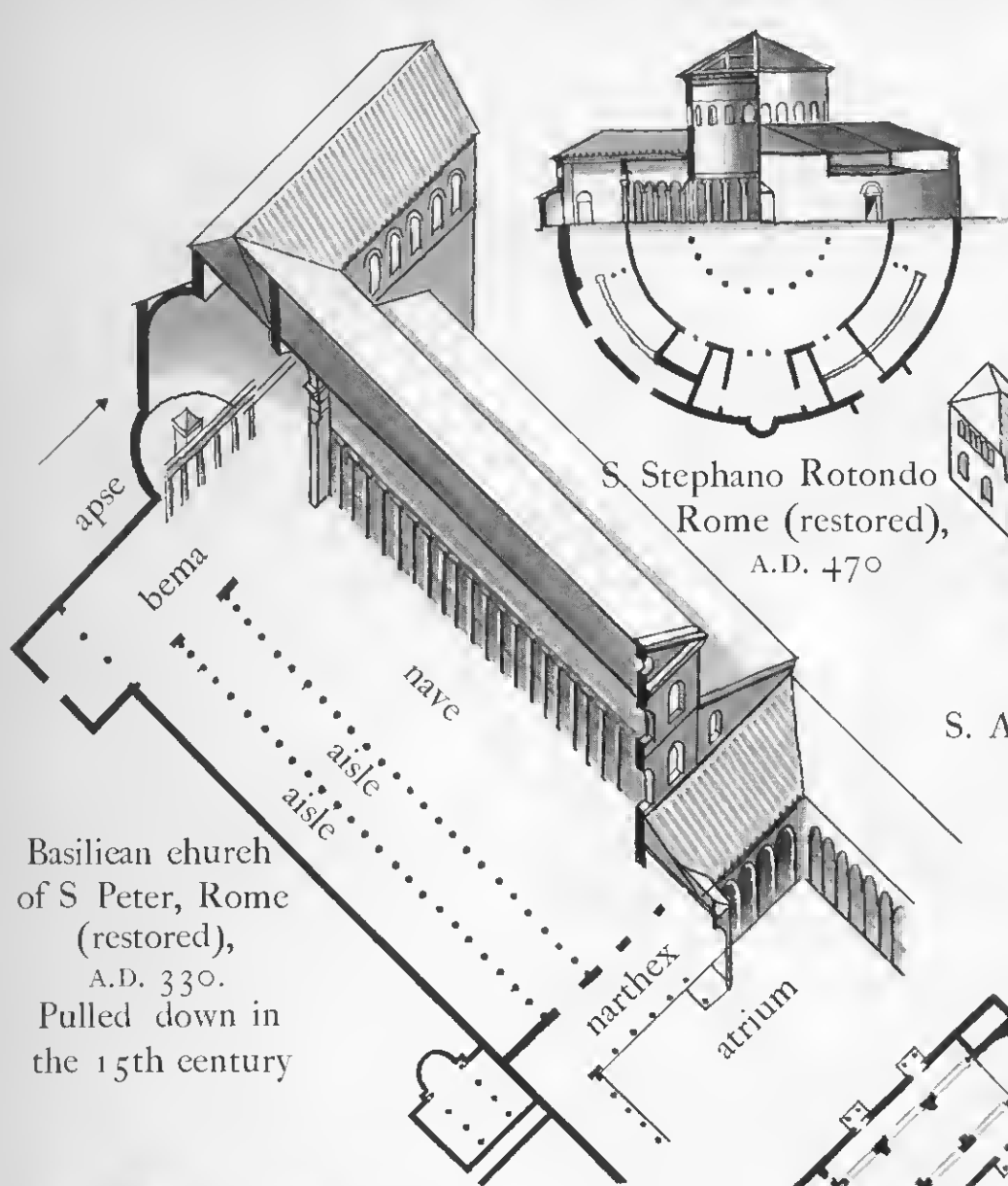
Arch of Septimius Severus, Rome, A.D. 200



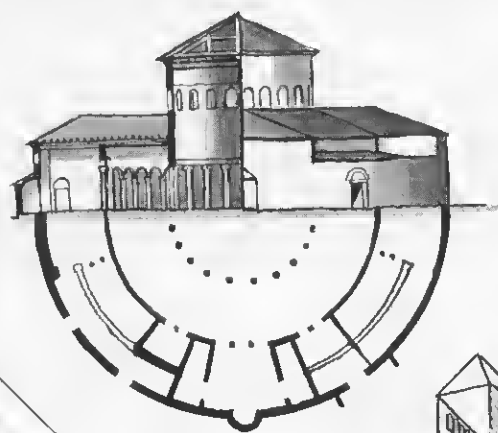
The Library, Ephesus (restored),
c. A.D. 115. Lower storey Composite
and upper storey Corinthian order,
both having smooth shafts

Rock-cut tomb of Khazna,
Petra, c. A.D. 120.
One of the 25 rock-cut façades

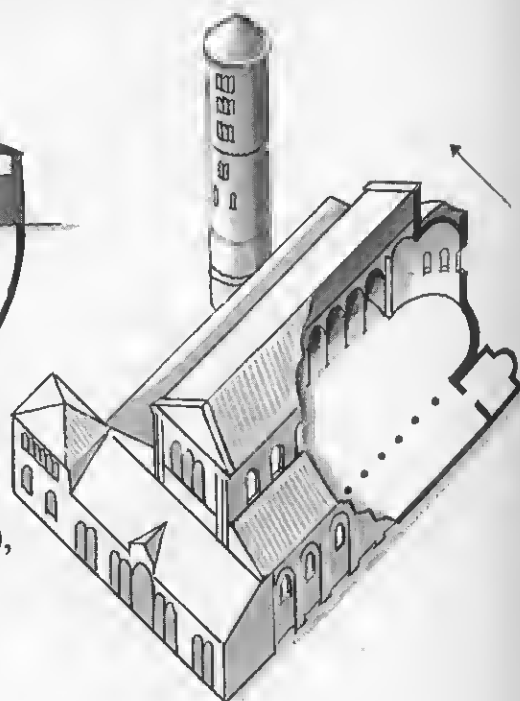
EARLY CHRISTIAN



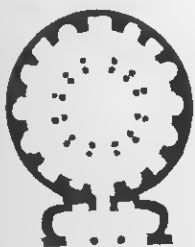
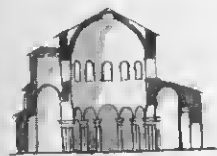
Basilican church
of S Peter, Rome
(restored),
A.D. 330.
Pulled down in
the 15th century



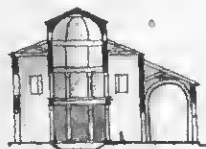
S. Stephano Rotondo
Rome (restored),
A.D. 470



S. Apollinare in Classe, Ravenna,
A.D. 534-539

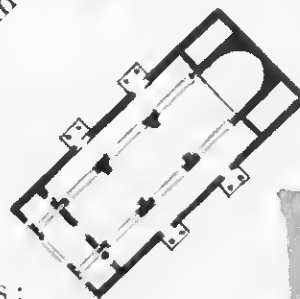


S. Costanza,
Rome,
A.D. 330

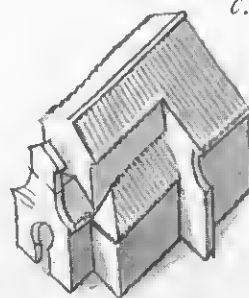
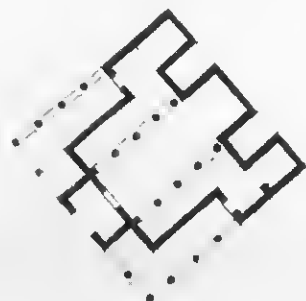


Baptistry of
Constantine,
Rome,
A.D. 430-440

Syria,
5th-6th centuries:
churches built of large
stone blocks and
timber roofs




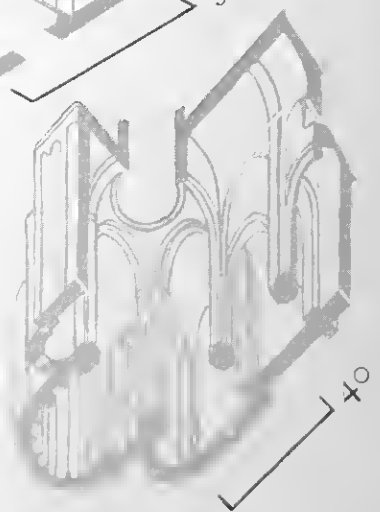
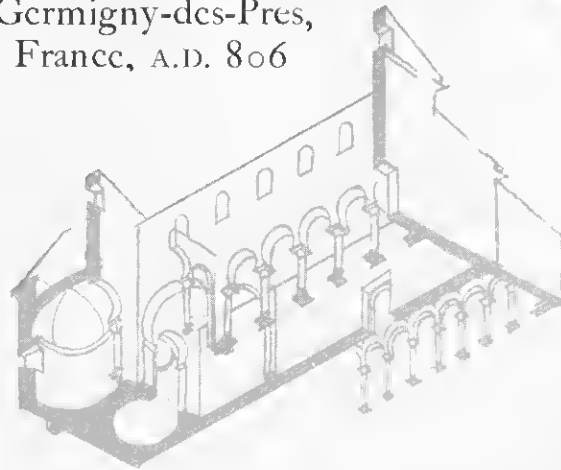
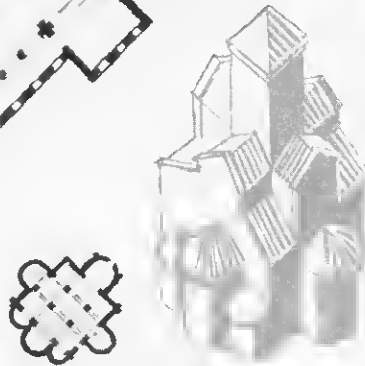
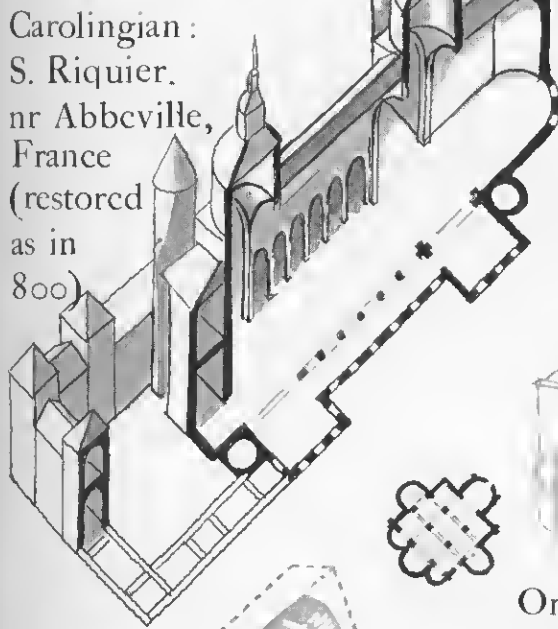
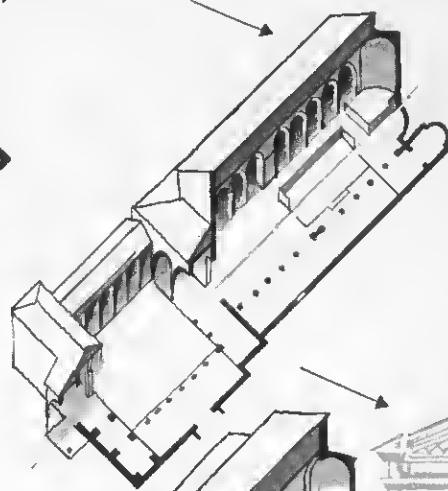
Church, Roueiha (restored),
c. 6th century A.D.



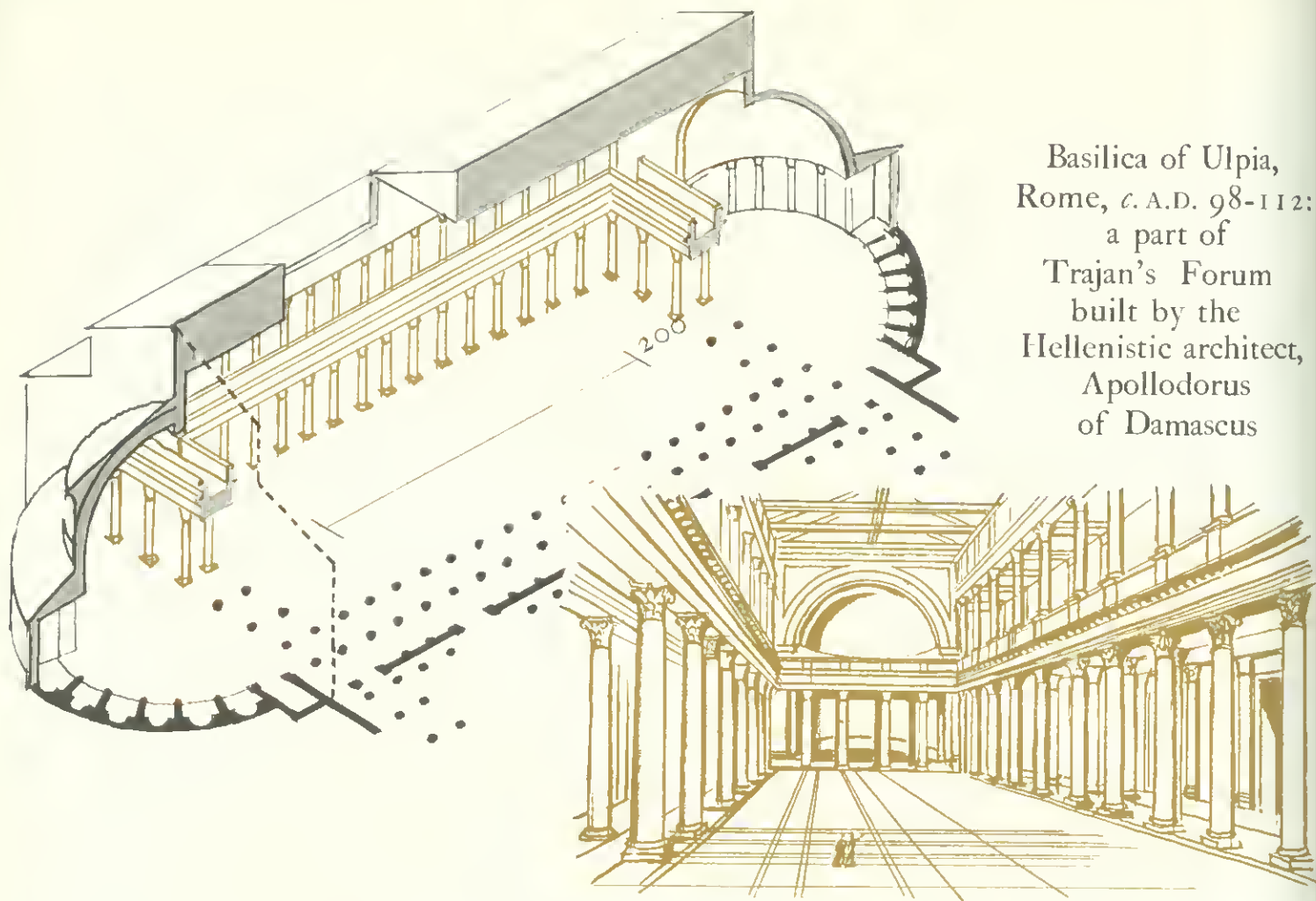
Visigothic before the Moslem invasion, with horse-shoe arch:
S. Juan de Baños, Cerrato, Spain, c. A.D. 500-713

COMPARATIVE PLANS

plans and sections in black to the same scale  150

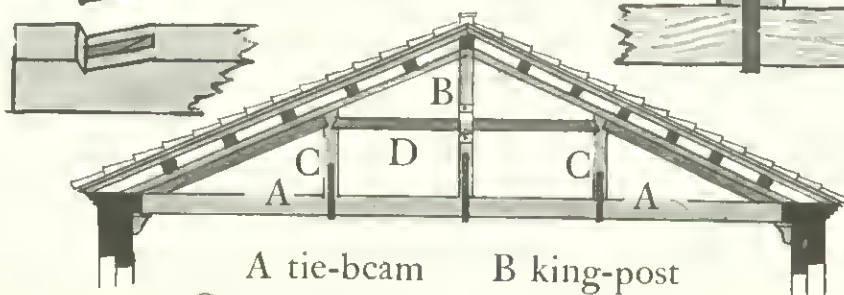
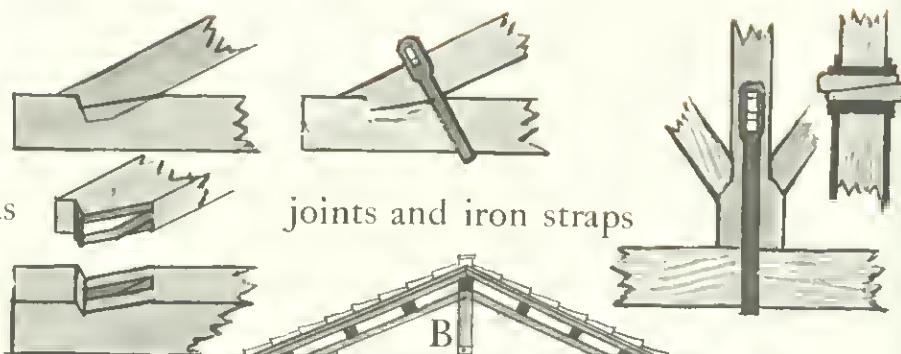
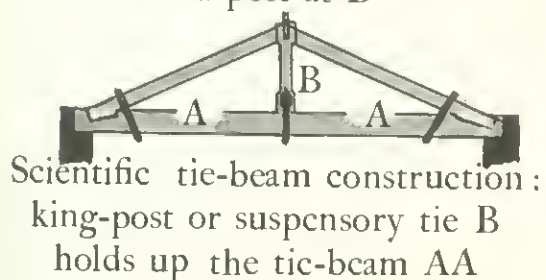
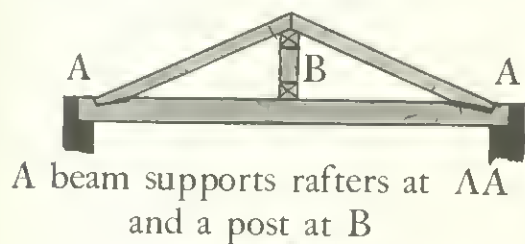
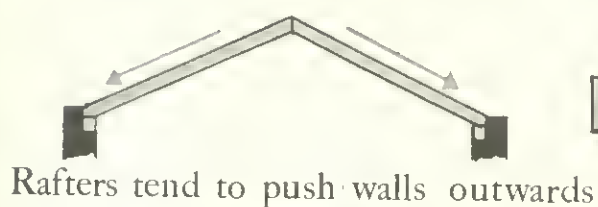


ROMAN BASILICA EARLY

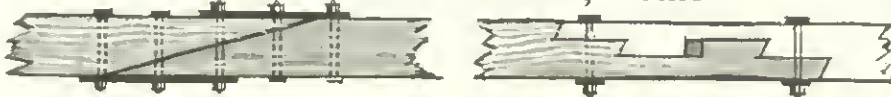


Basilica of Ulpia,
Rome, c. A.D. 98-112:
a part of
Trajan's Forum
built by the
Hellenistic architect,
Apollodorus
of Damascus

TIMBER ROOFS

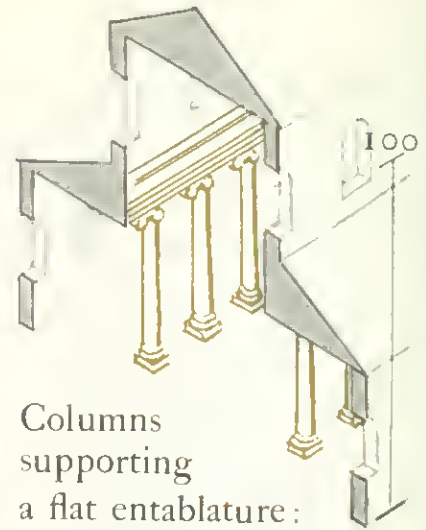
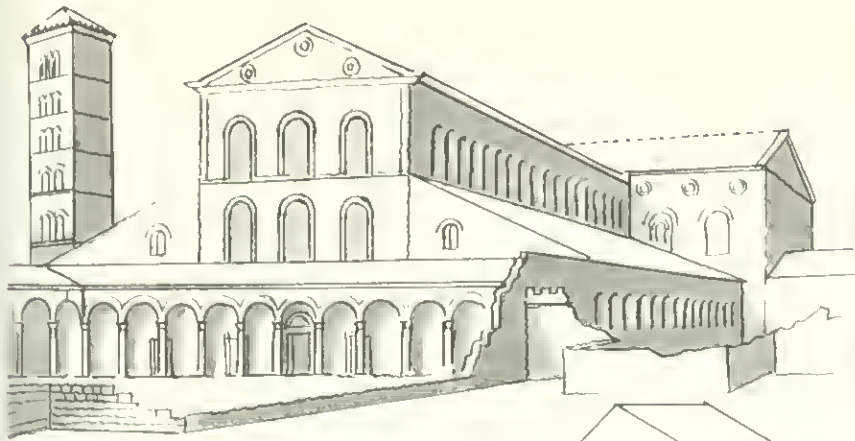


S. Paolo fuori le Mura, Rome

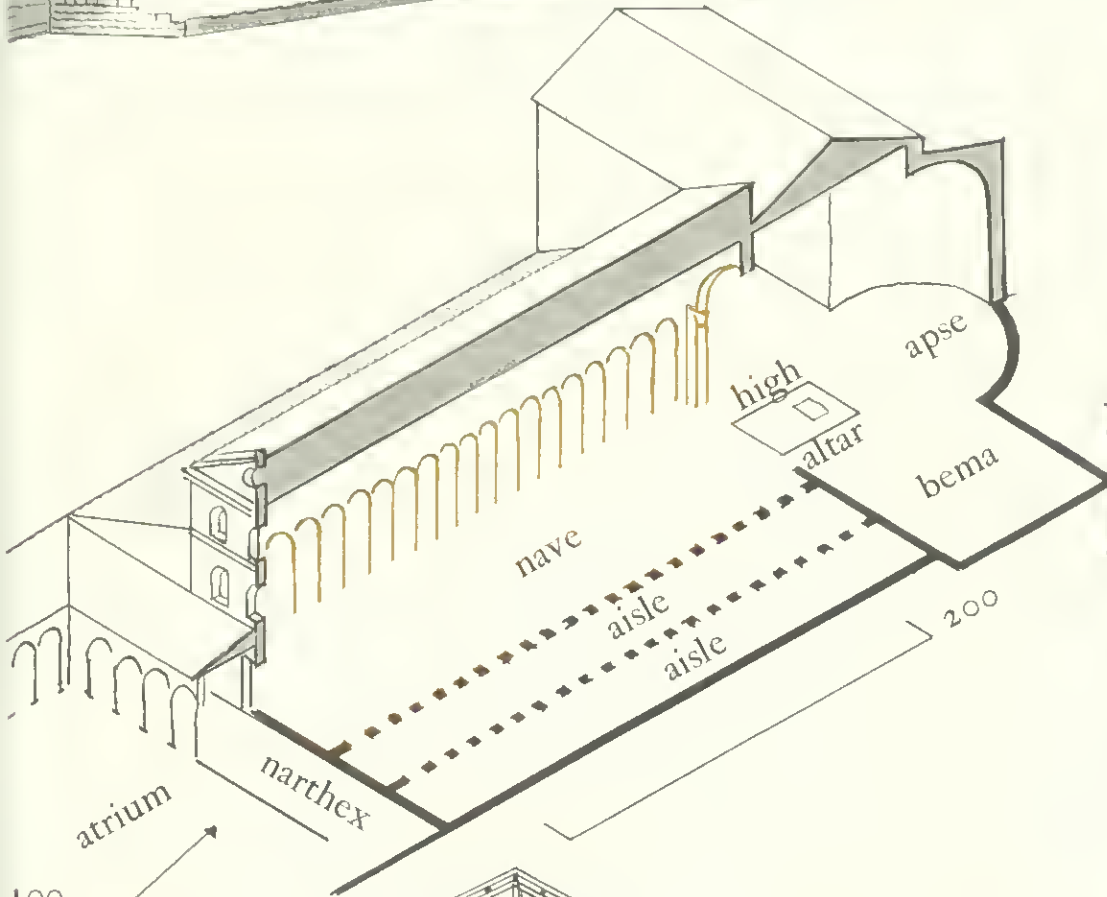


CHRISTIAN

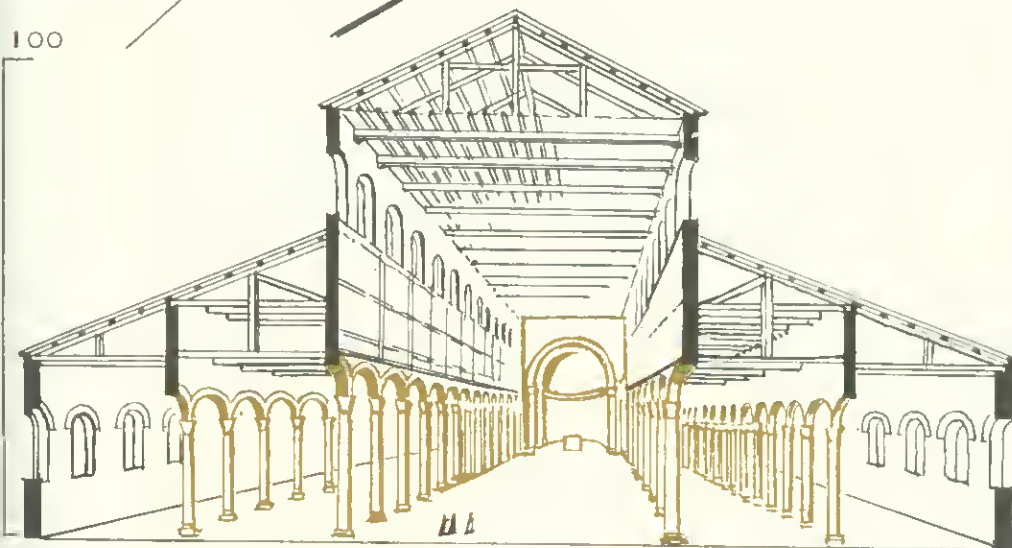
CHURCHES



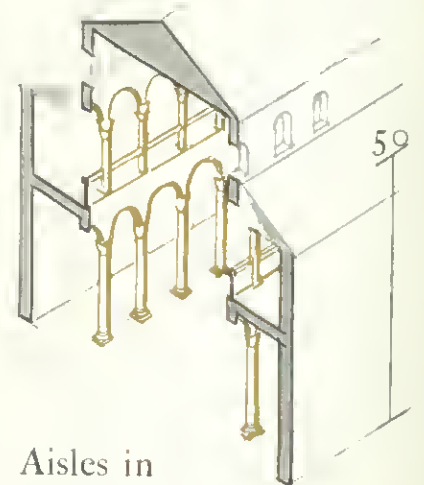
Columns supporting a flat entablature:
S. Maria Maggiore, Rome, A.D. 432



Columns supporting semi-circular arches:
S. Apollinare in Classe, Ravenna, A.D. 534-539



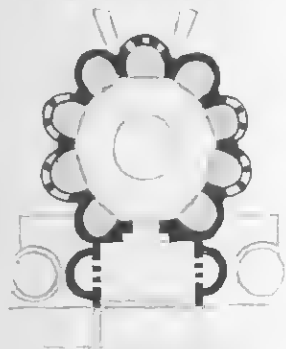
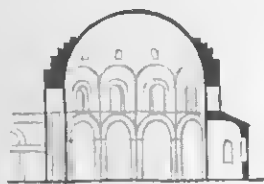
Basilican church of S. Paolo fuori le Mura, Rome, A.D. 320; burnt down in 1832 and rebuilt to the original design



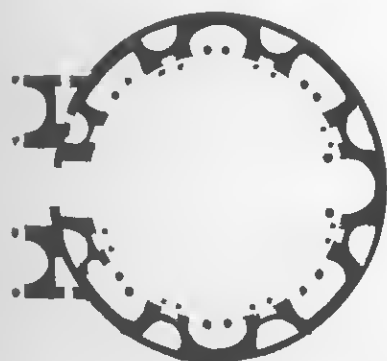
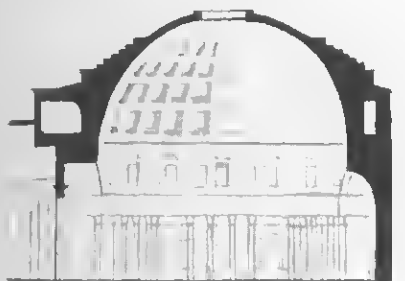
Aisles in two storeys:
S. Agnese fuori le Mura, Rome, A.D. 625-638

BYZANTINE

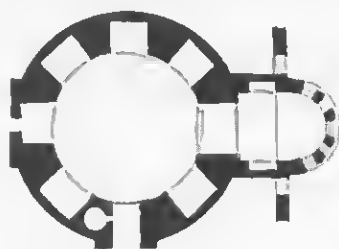
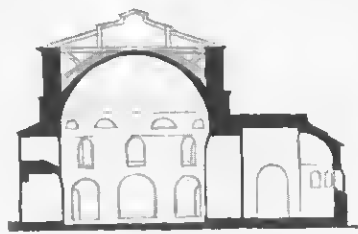
ROMAN



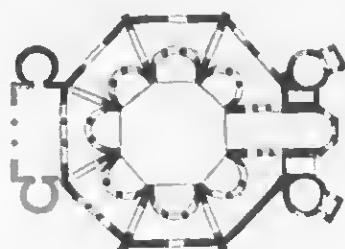
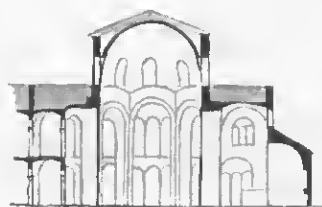
The Minerva Medica,
Rome, c. A.D. 260



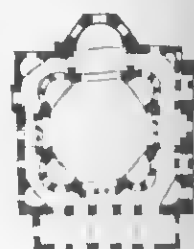
The Pantheon, Rome,
A.D. 120-124



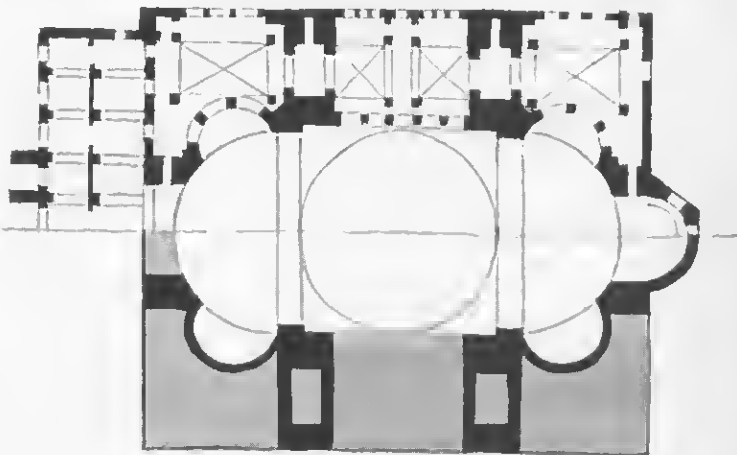
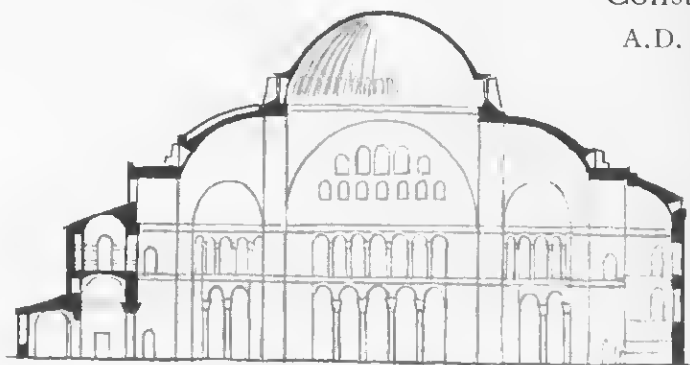
S. George, Salonika,
c. A.D. 400



S. Vitale, Ravenna,
A.D. 526-547

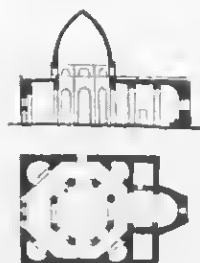
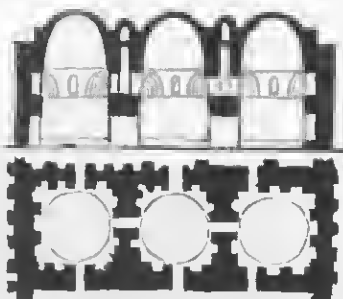


SS. Sergius
and Bacchus,
Constantinople
A.D. 527-553



S. Sophia, Constantinople, A.D. 532-537

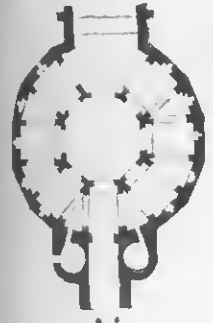
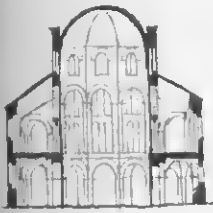
PERSIA:
detail of Palaeo,
Feruz-abad,
A.D. 450



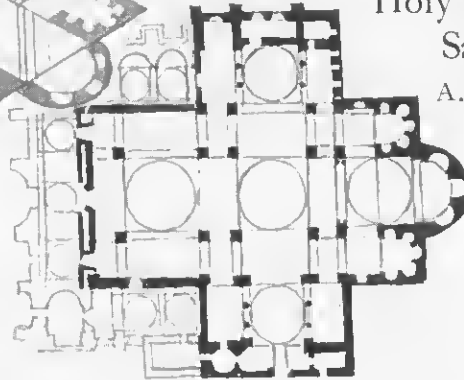
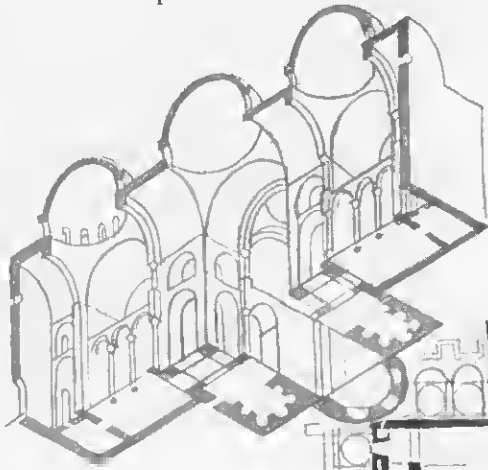
SYRIA:
S. George,
Ezra,
c. A.D. 510

COMPARATIVE PLANS

plans and sections in black to the same scale  150



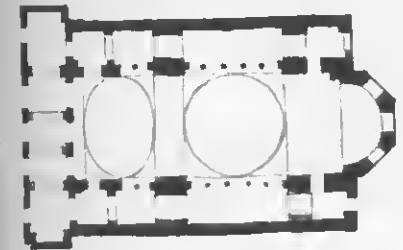
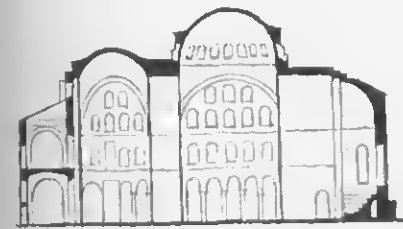
Carolingian
cathedral,
Aix-la-Chapelle,
A.D. 796-804



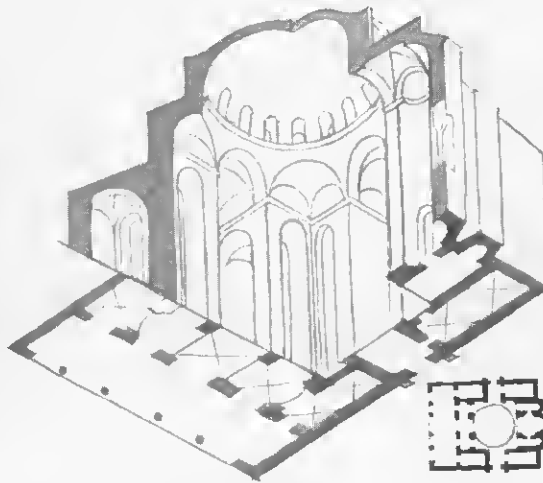
S. Mark, Venice, A.D. 1042-1085



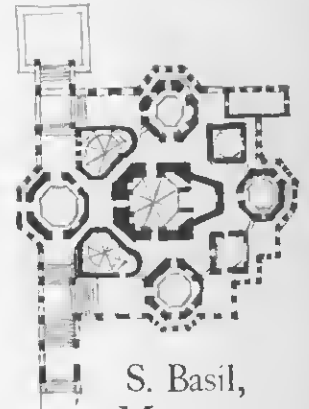
Holy Apostles,
Salonika,
A.D. 1200



S. Irene, Constantinople,
A.D. 740



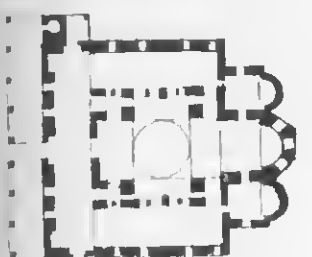
Church, Daphni, nr Athens,
c. 11th century A.D.



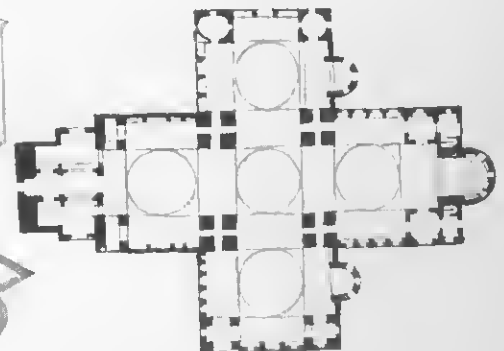
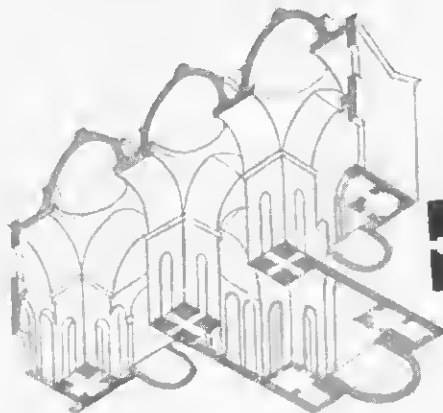
S. Basil,
Moscow,
A.D. 1554-1560



S. Saviour
Pantepoptes,
Constantinople,
early 12th century

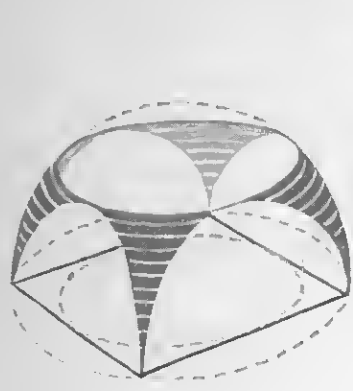


S. Sophia, Salonika,
c. 6th century A.D.

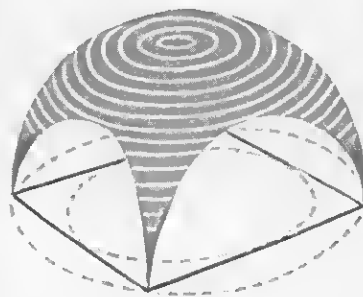
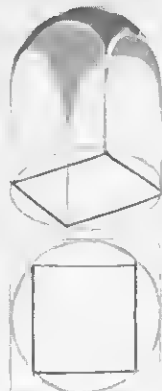


S. Front, Perigucux, France, A.D. 1120

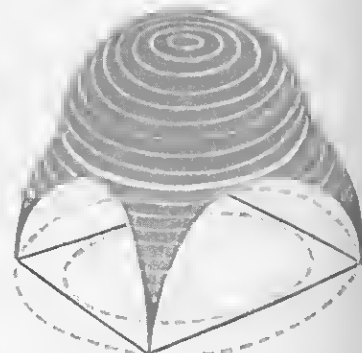
BYZANTINE



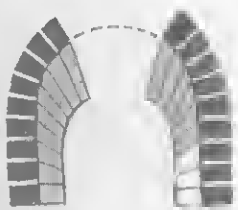
Pendentives



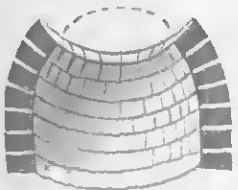
Dome and pendentives
parts of one hemisphere



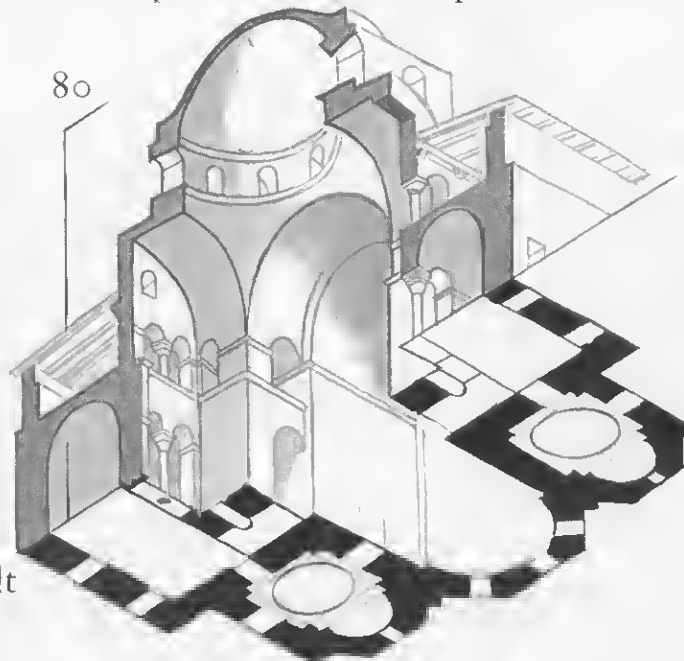
The dome a hemisphere
set above pendentives



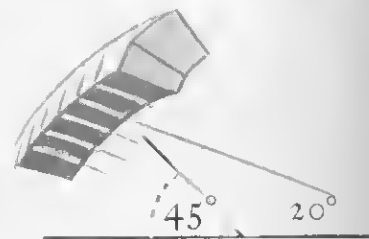
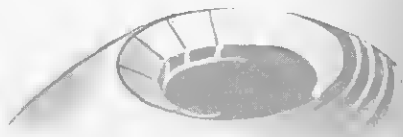
To build an arch
centering is necessary,



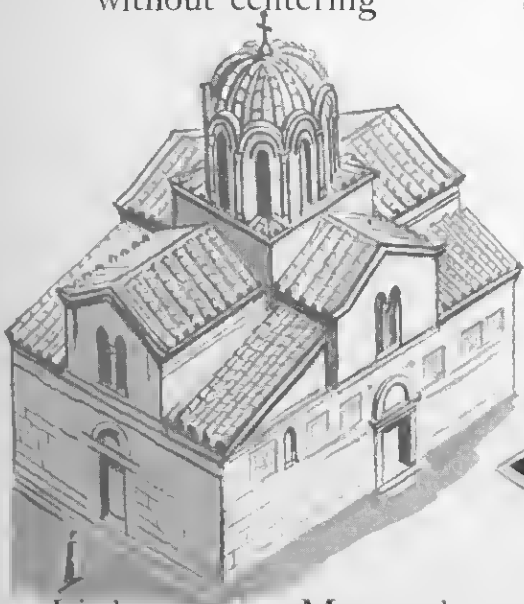
but a dome can be built
in successive rings
of horizontal arches
without centering



S. Sophia, Salonika, c. A.D. 495

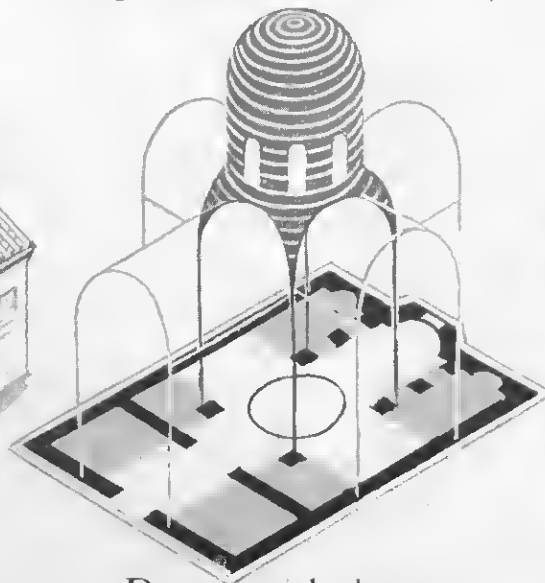


Domes on pendentives
built with bricks
not radiating
from centre

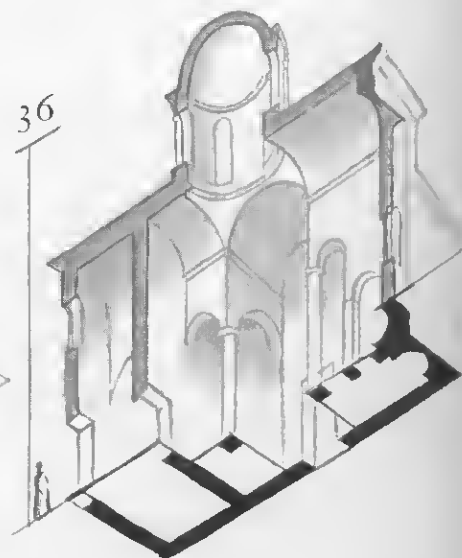


Little
Cathedral,

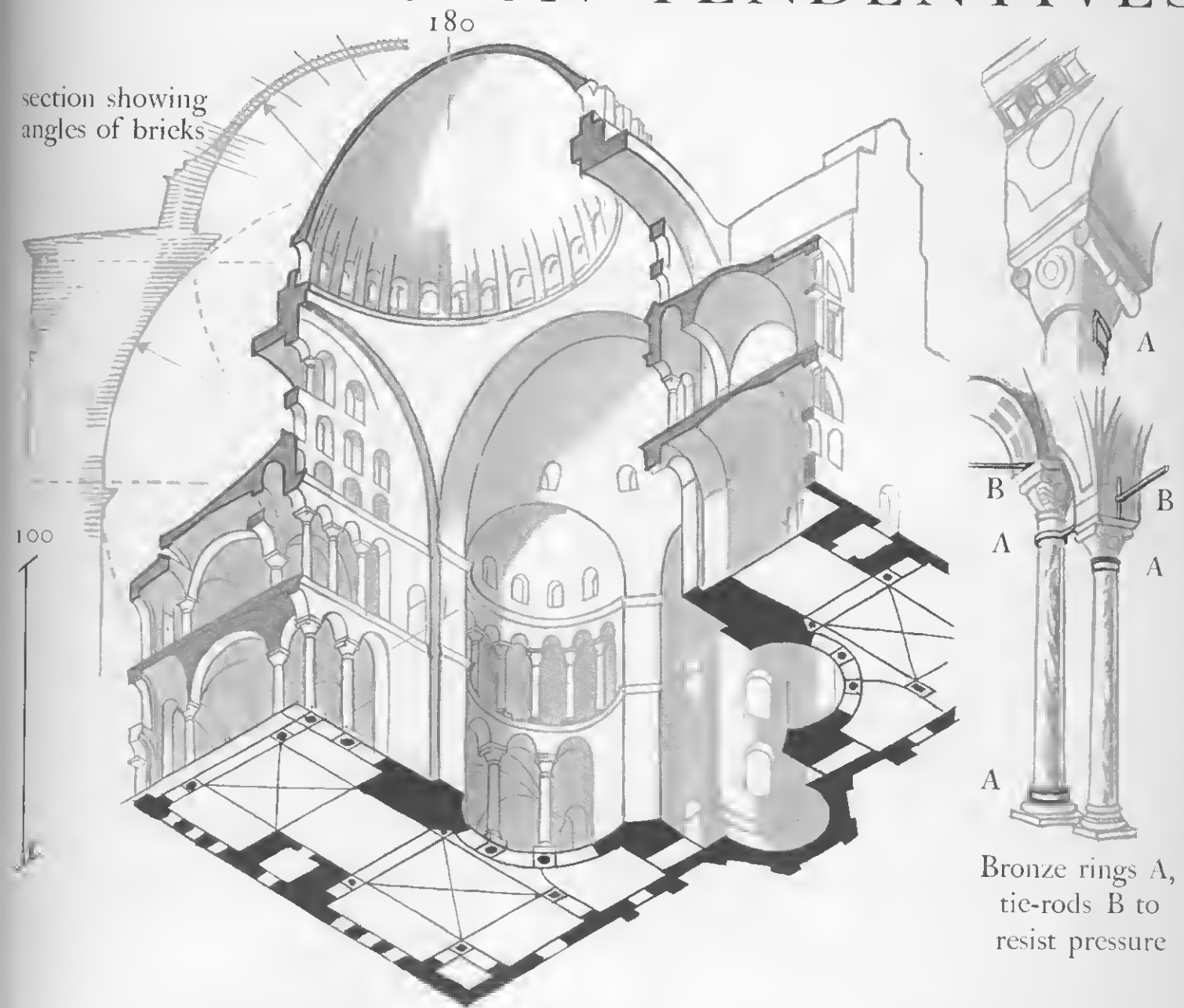
Metropole
Athens, A.D. 1250



Dome with drum:
cross-in-square plan

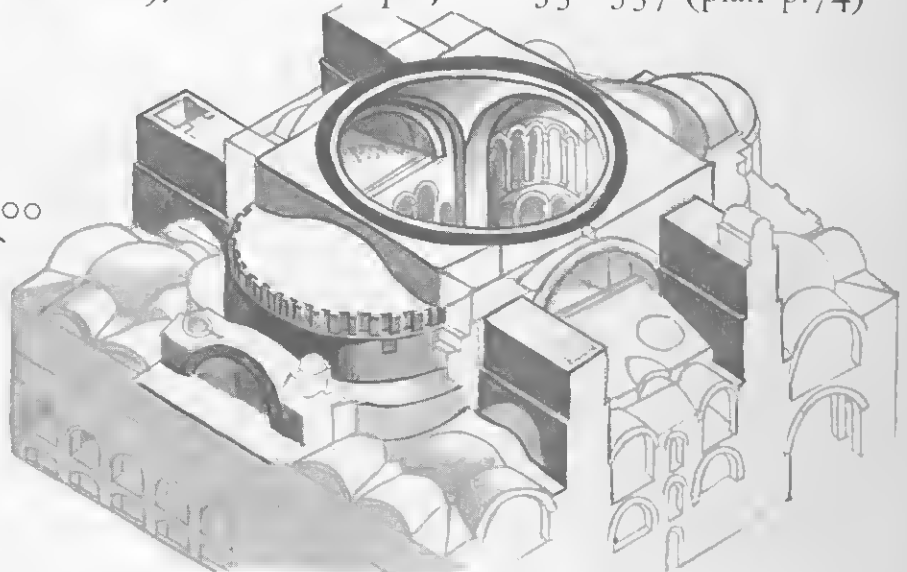


DOMES ON PENDENTIVES



S. Sophia (Hagia Sophia = divine wisdom), Constantinople, A.D.~532-537 (plan p.74)

Built for Justinian by two Greek architects, Anthemius of Tralles and Isidorus of Miletus. Built of brick; the dome probably erected without centering, with bricks about 24-27 inches square and 2 inches thick laid in deep mortar and covered with $\frac{1}{4}$ inch lead; the dome supported on 4 piers, the thrust being taken by 2 semi-domes and 4 massive buttresses; the interior lined throughout in coloured marbles and mosaics



ROMANESQUE

plans and elevations
to the same scale

200

ITALY

S. Miniato, Florence, 1062

FRANCE

Pisa Cathedral, 1063-1272

S. Riquier,
nr Abbeville
(restored), c. 799

S. Philibert, Tournus,
c. 950-1120 & later

chevet
1156
Abbaye-aux-
Hommes (S. Etienne),
Caen, 1066-1077

GERMANY

S. Cyriakus, Gernrode,
961 and later

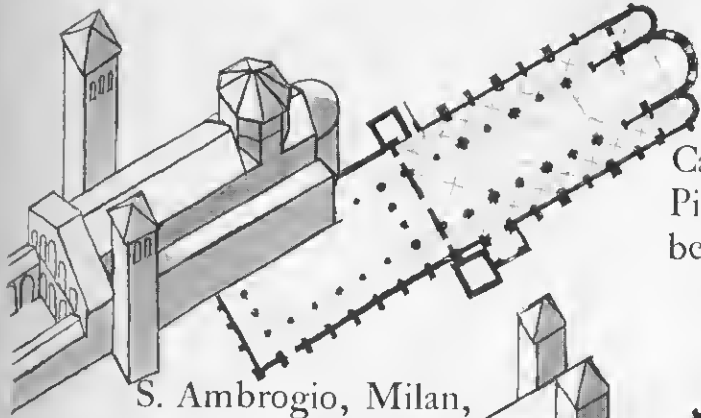
Speyer Cathedral
1031-61 & 12th century

SPAIN

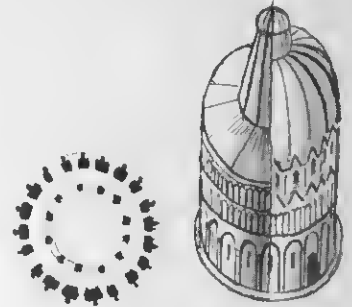
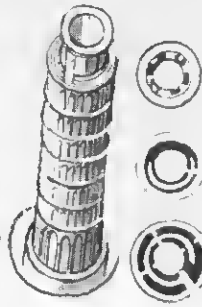
Ripoll Abbey,
Catalonia, 1020-1032

Santiago de Compostela,
c. 1075-1121: pilgrimage church similar in plan
to Tours, Limoges, Conques and Toulouse

PLANS & ELEVATIONS



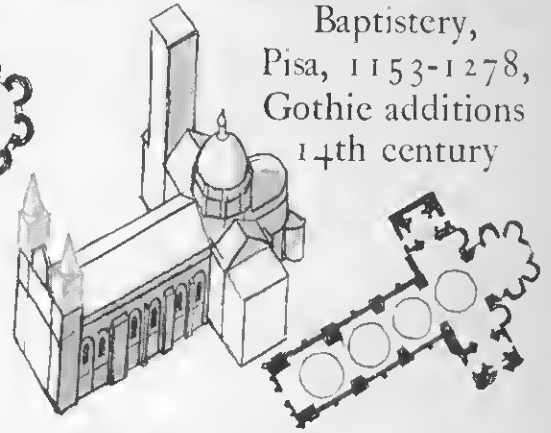
Campanile,
Pisa, 1174;
belfry 1350



Baptistry,
Pisa, 1153-1278,
Gothic additions
14th century

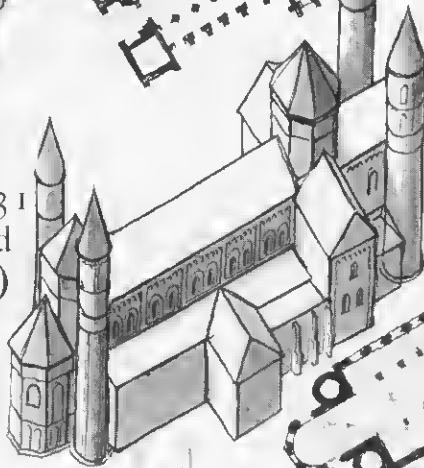


Cluny Abbey III
(restored), 1088-1131
(elevation reversed
to show the apse)

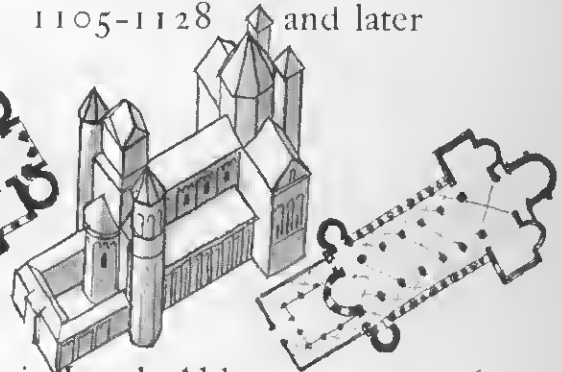


Angoulême Cathedral,
1105-1128 and later

GERMANY

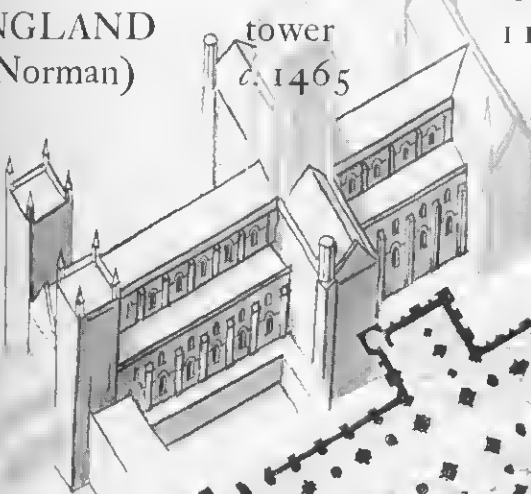


Worms Cathedral,
1105-1128 and later



Maria Laach Abbey, 1093-1156

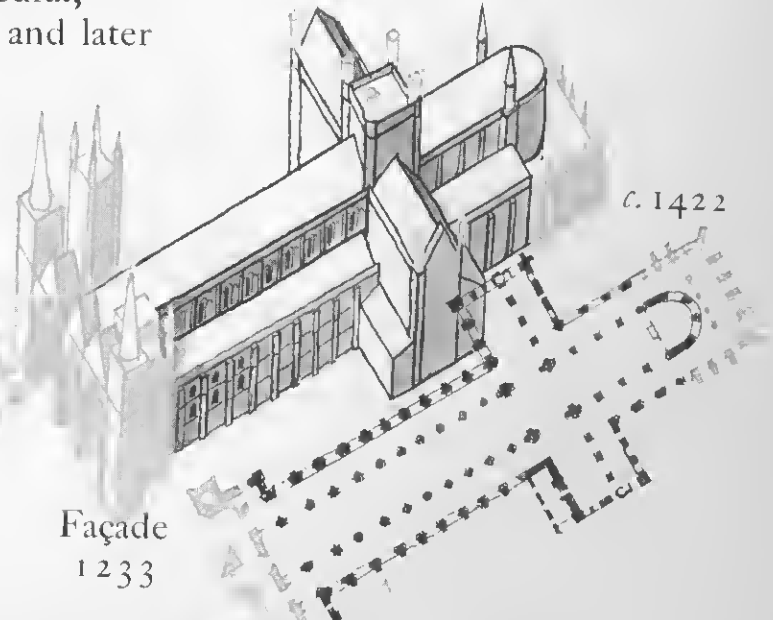
ENGLAND (Norman)



1170-
1175

Durham Cathedral, 1093-1133

1240-
1290



Façade
1233

Peterborough Cathedral, 1177-1190

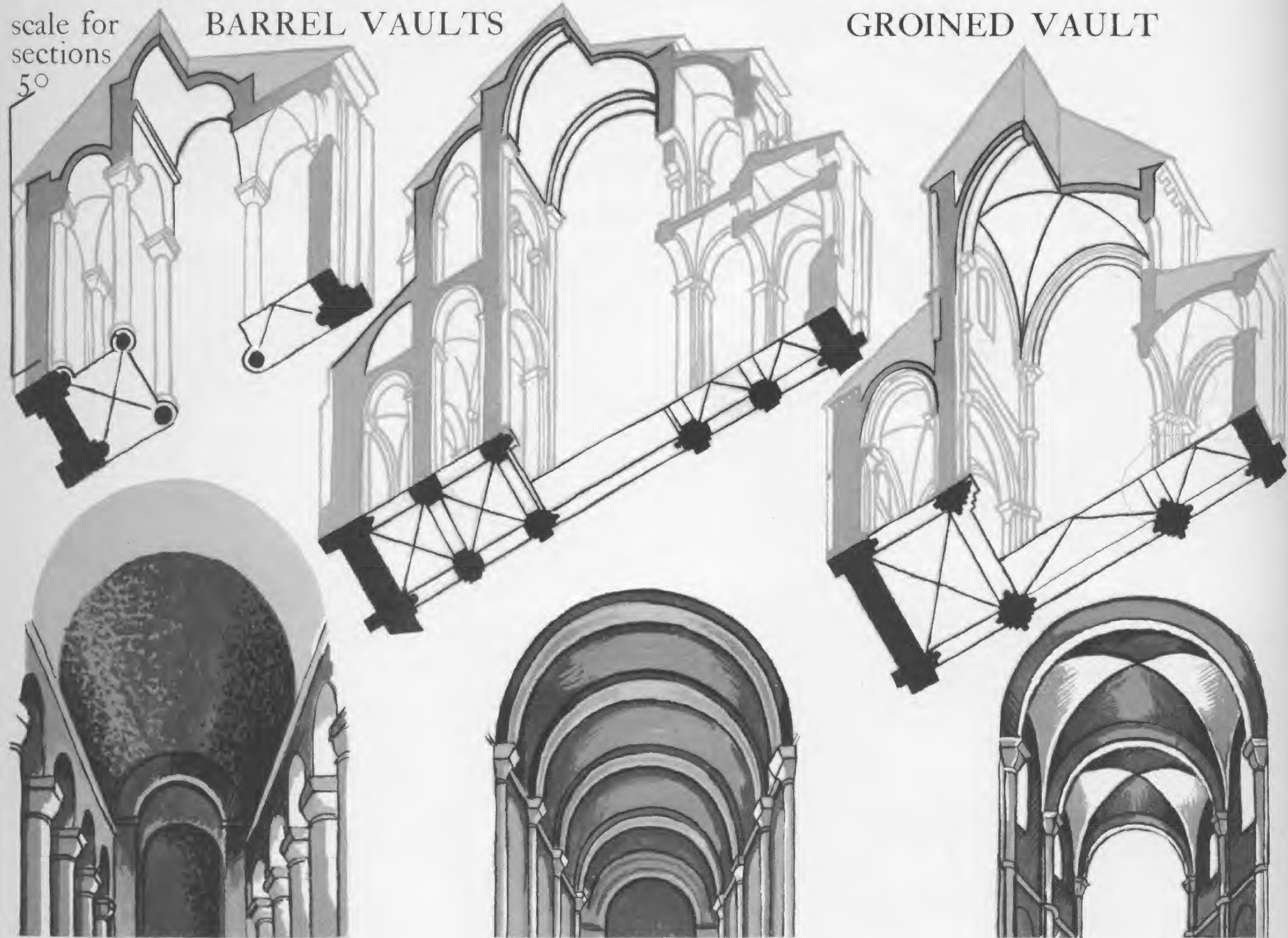
c. 1422

ROMANESQUE

scale for
sections
50

BARREL VAULTS

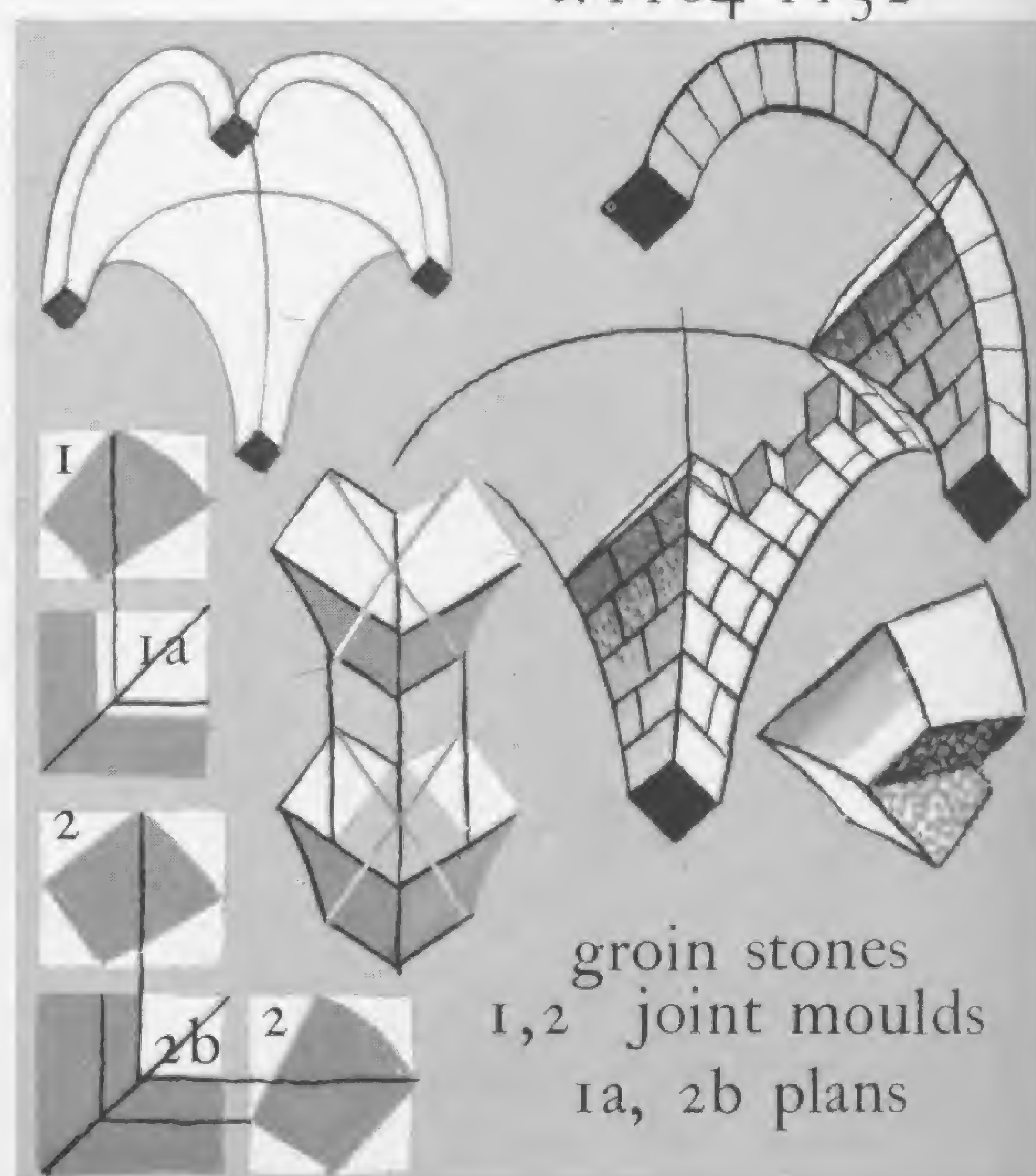
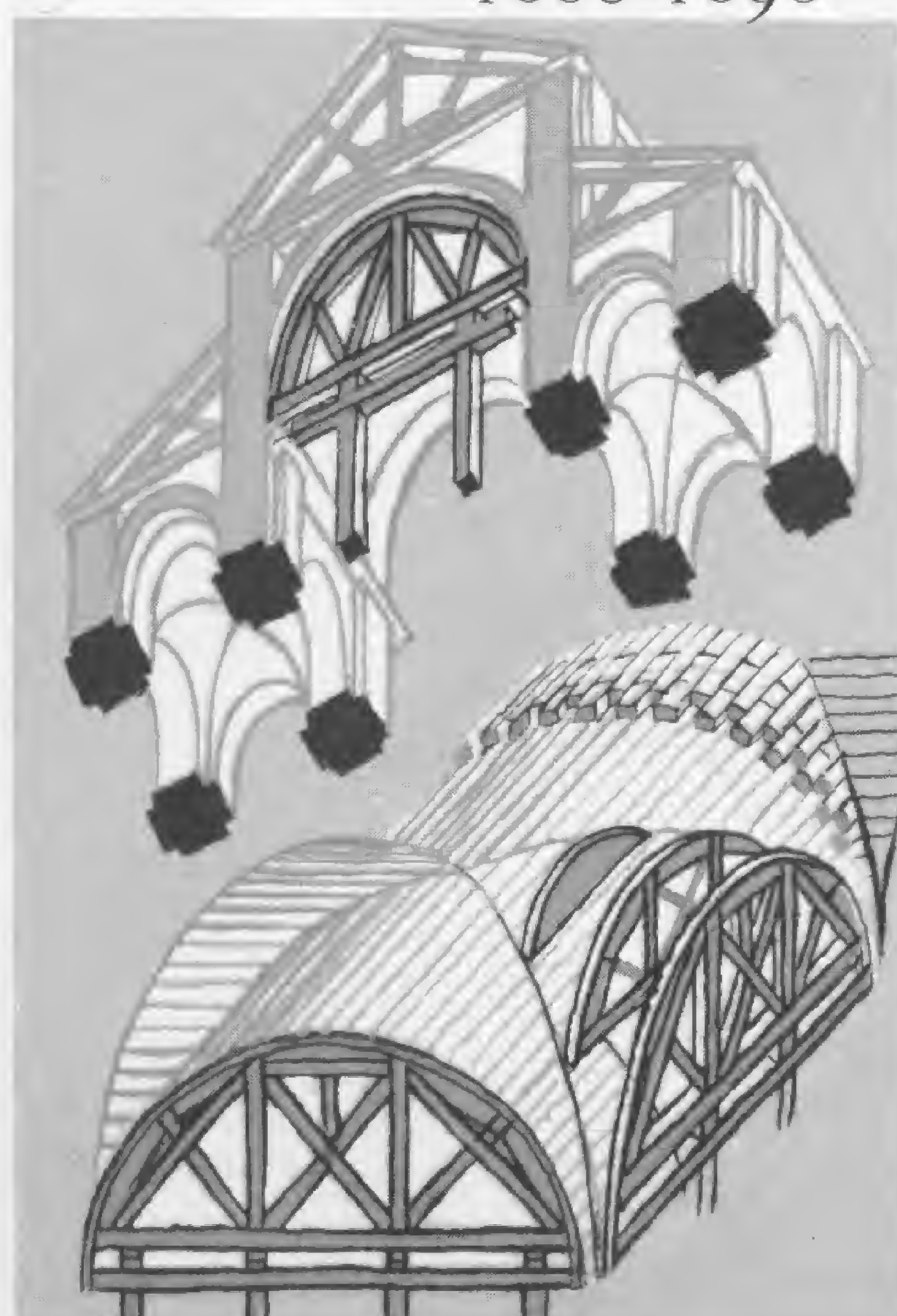
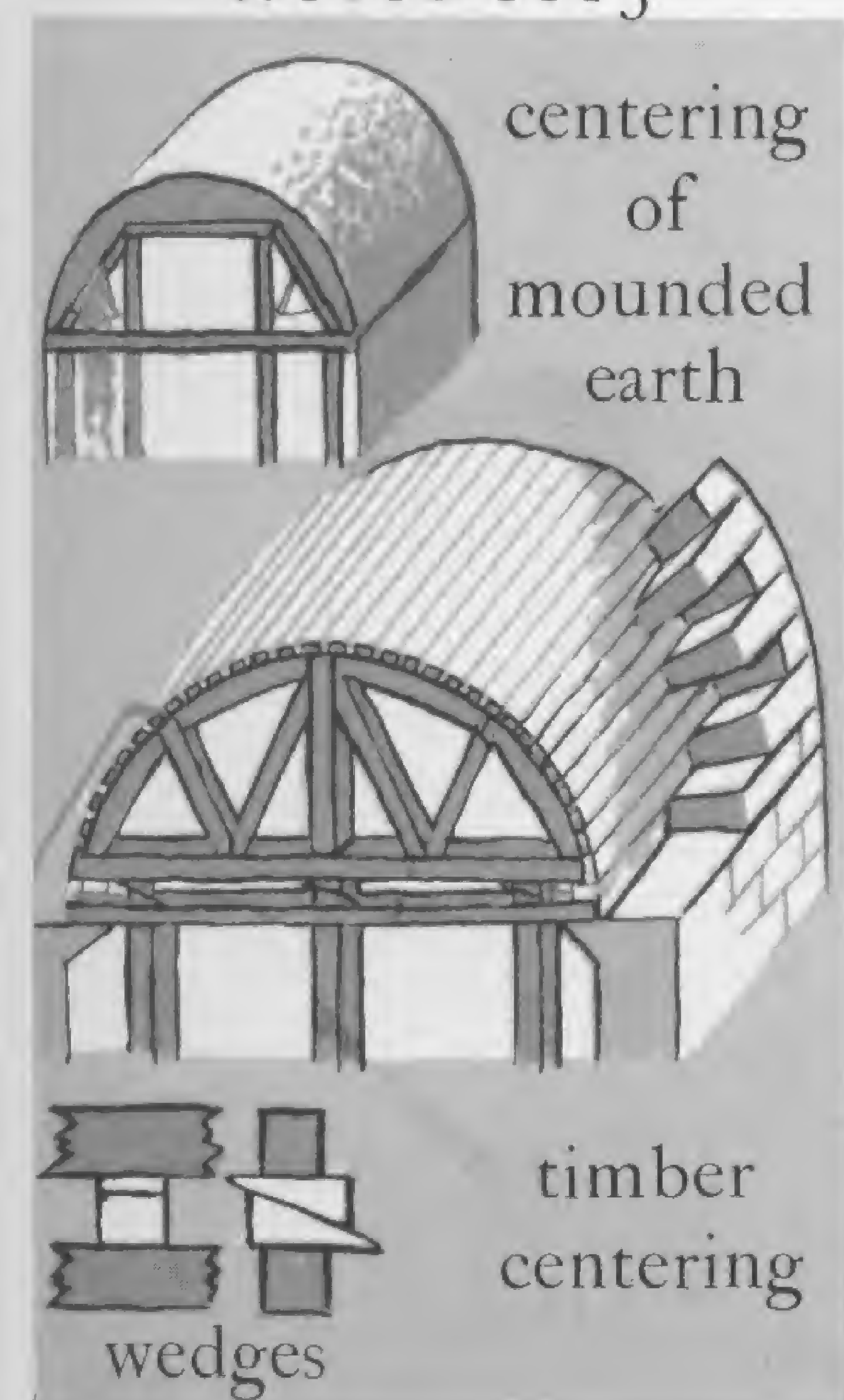
GROINED VAULT



S. Savin-sur-Gartempe,
c. 1060-1115

S. Sernin, Toulouse,
1080-1096

S. Madelaine, Vézelay,
c. 1104-1132

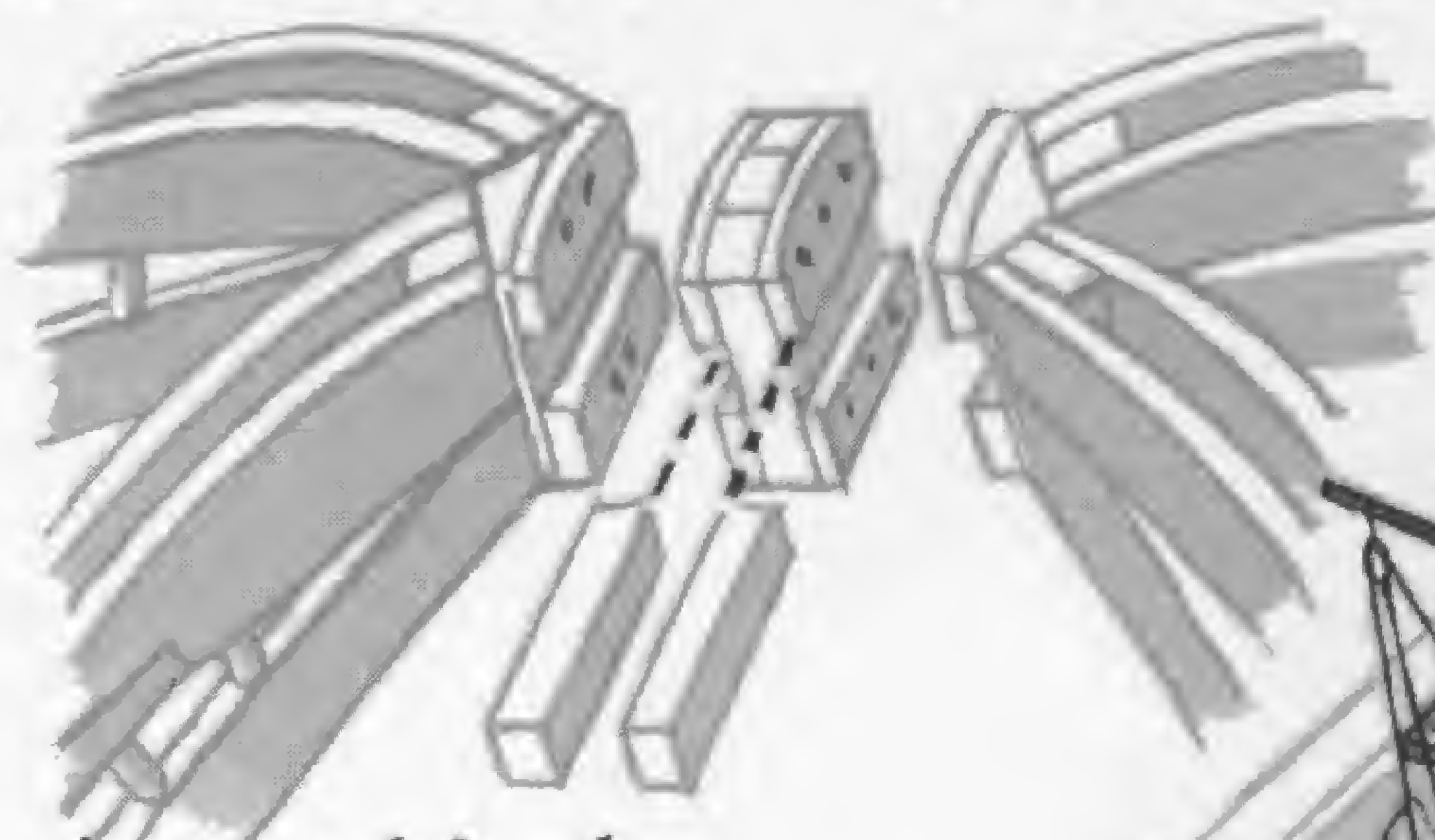


STONE VAULTING

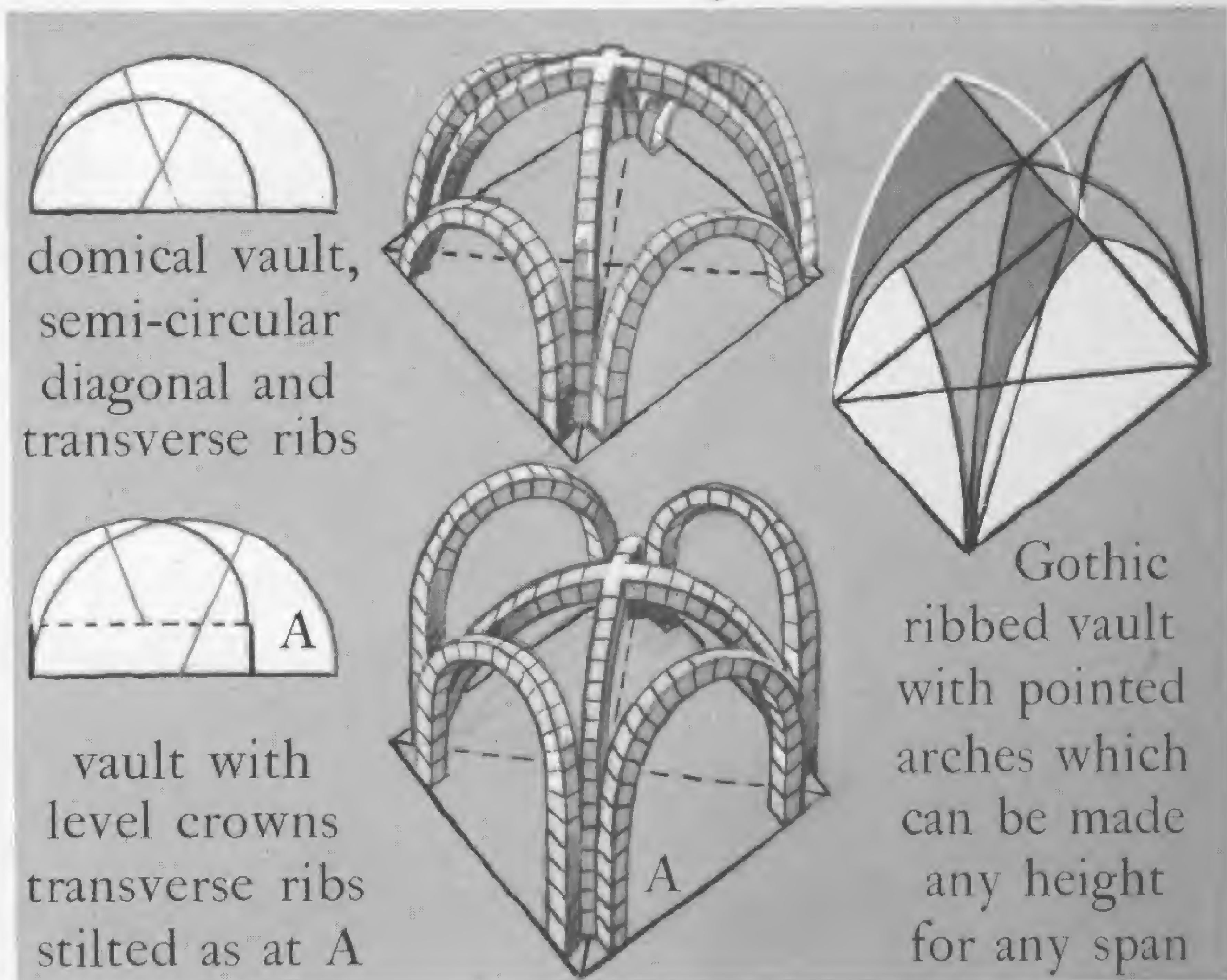
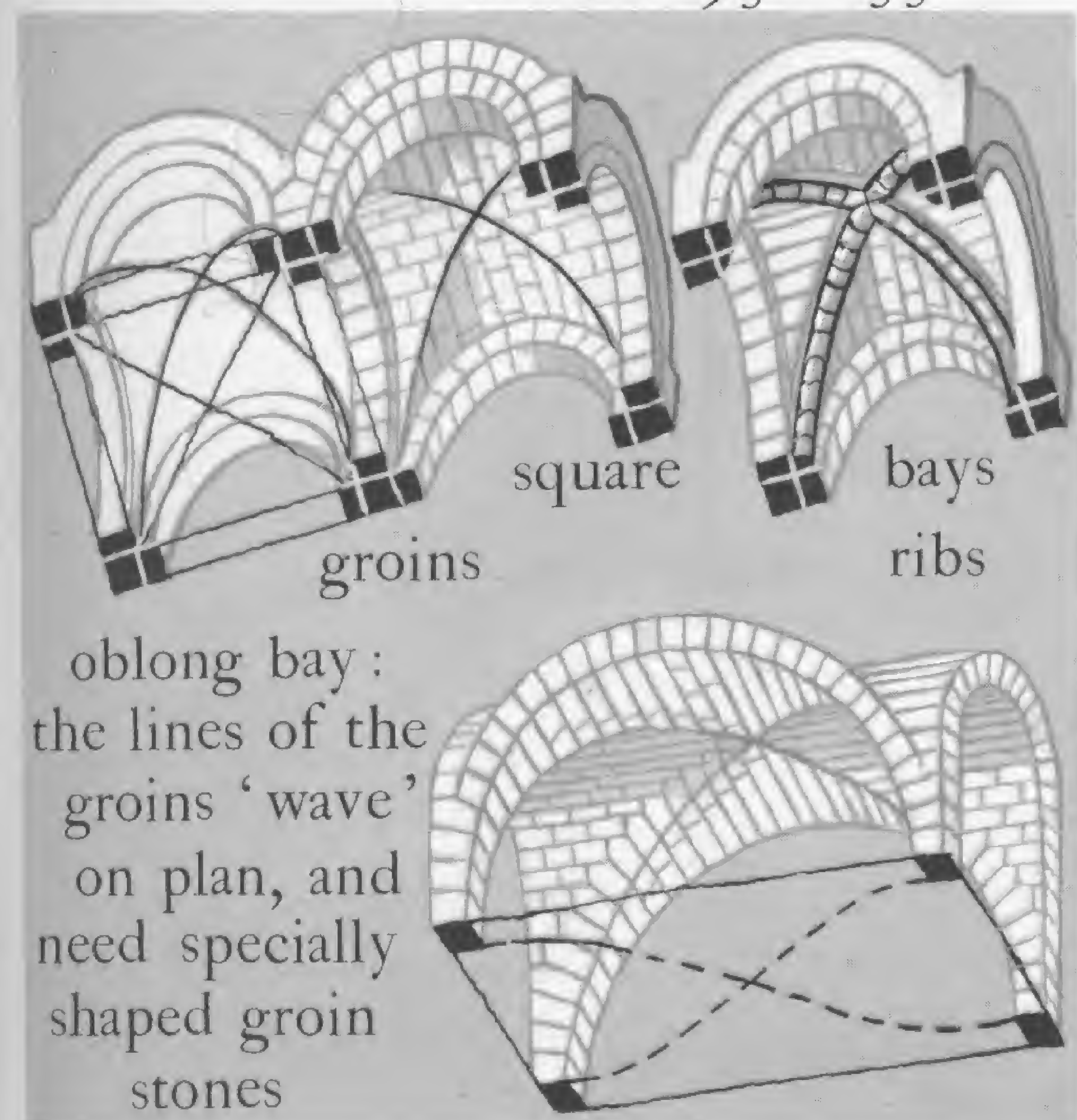
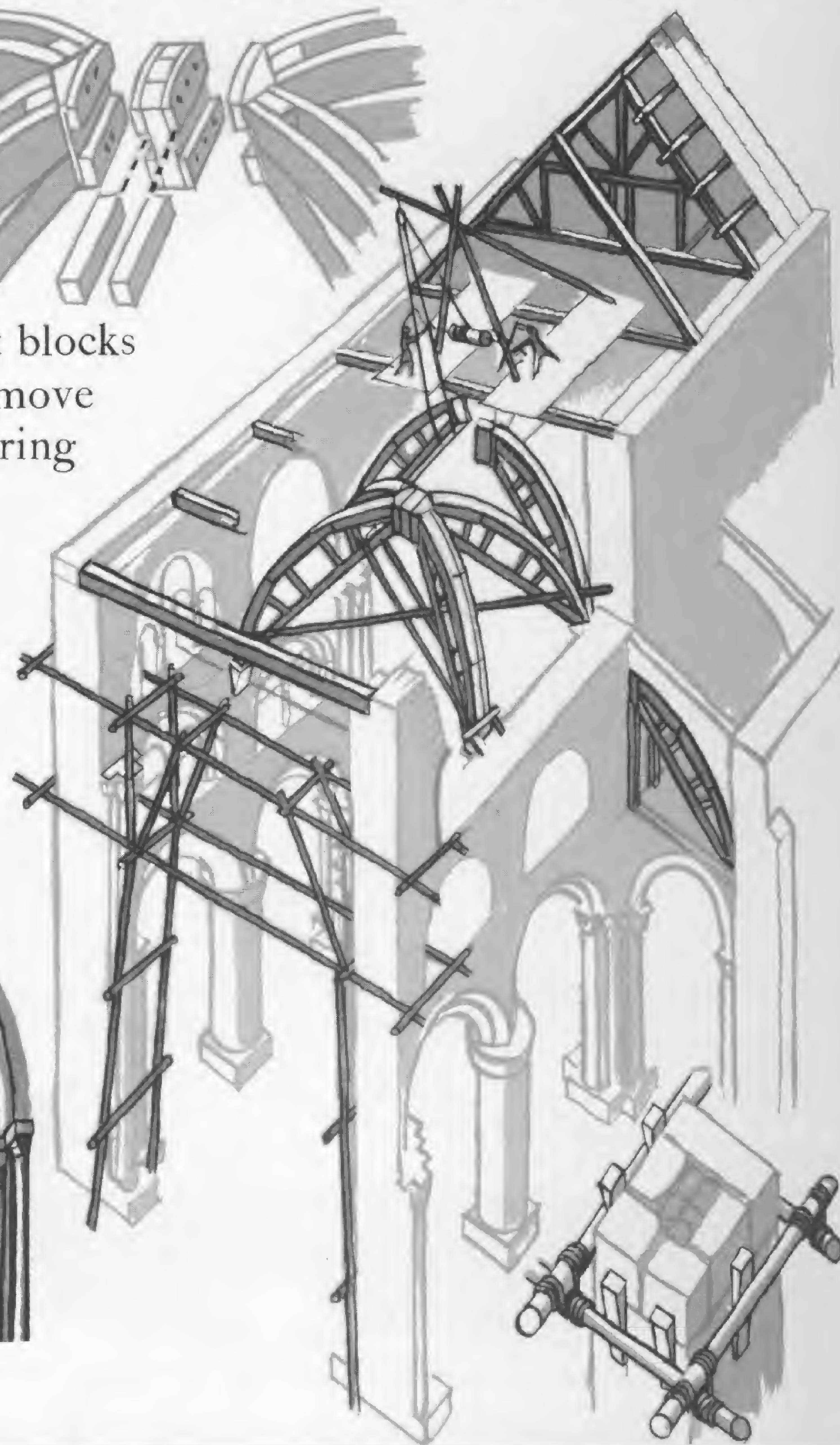
RIBBED VAULT



Durham Cathedral:
nave 1093-1133



insert blocks
to remove
centering

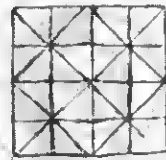


GOTHIC



INTRODUCTION

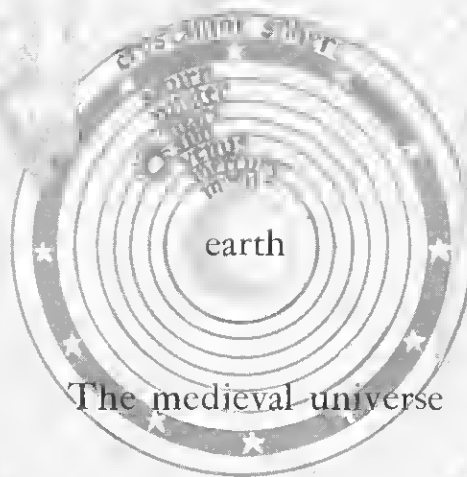
1100	1200	1300	1400	1500	1550
Increase of trade, growth of towns, & rise of guilds	Ascension of Gothic in Ile de France	Black Death 1348-49 1346-The 100 Years' War-1453	1453	End of Eastern Byzantine Empire	
Universities Aristotle (via Arabs) c.1225	Scholasticism S. Aquinas-c.1275 1265-Dante-1321	Humanism 1304-Petrarch-1374	Italian RENAISSANCE 1452-Leonardo da Vinci-1519		
Discoveries: optical lens, mariner's compass, gunpowder, cannon	1214-Roger Bacon-1294	c.1450 printing			



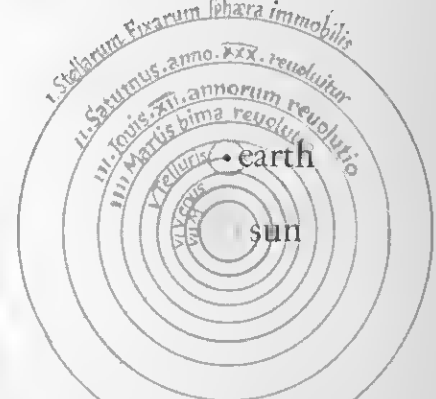
Columbus
1492

Magellan
1519-22

Map of the world, 1527



The medieval universe



The universe according to
1473—Copernicus—1543

The enlargement of S. Denis, 1144 (p.89) inaugurated a lyrical form of construction in which pointed arches, high stone vaults and flying buttresses were fused into an organic whole, and which reached a crescendo in the cathedrals built in the Ile de France (pp.100-101). Gothic, or the 'style Ogivale' (Fr.: pointed) was known as 'Opus Modernum' or 'Opus Francigenum' (French work); the term 'Gothic', i.e. barbarian, was first used by the Humanists of the Renaissance. Few plans survive by the lay master-masons, who designed their buildings with 'a good wit of geometry' and who directed the quarry-men, stone-cutters, smiths, carpenters & workmen. In England (pp.102-105), France (pp.106-107), Italy (pp.108-109) and Germany (pp.110-111) castles, parish churches, guild-halls and houses followed the same pattern of pointed arches, pinnacles, spires & high-pitched roofs. South of the Alps in Italy Gothic was neutralised by the Roman tradition and ceased with the advent of the Renaissance in the 15th century.

GOTHIC

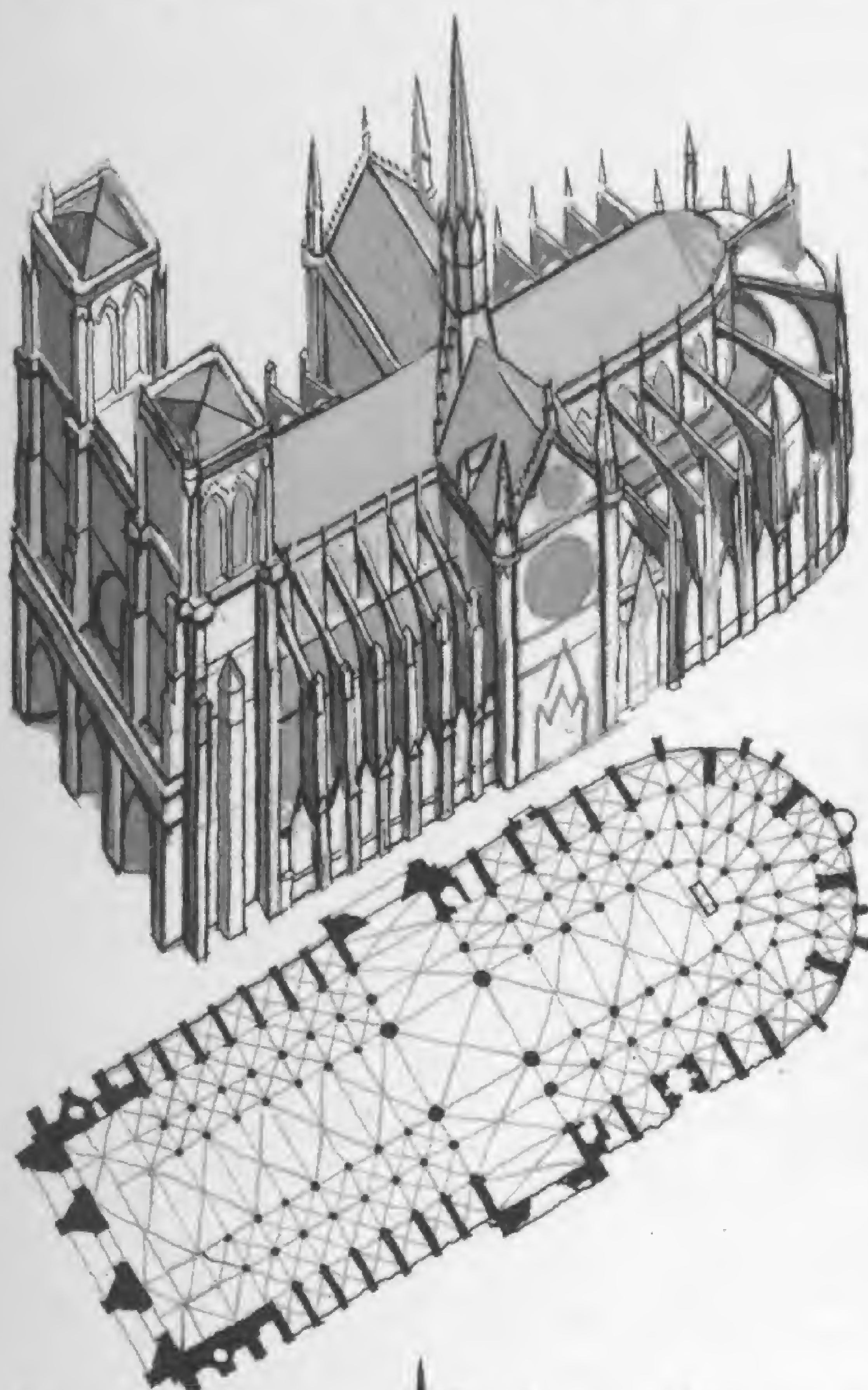
plans
and elevations
to the same scale

Amiens Cathedral,

1220-1288

200

FRANCE

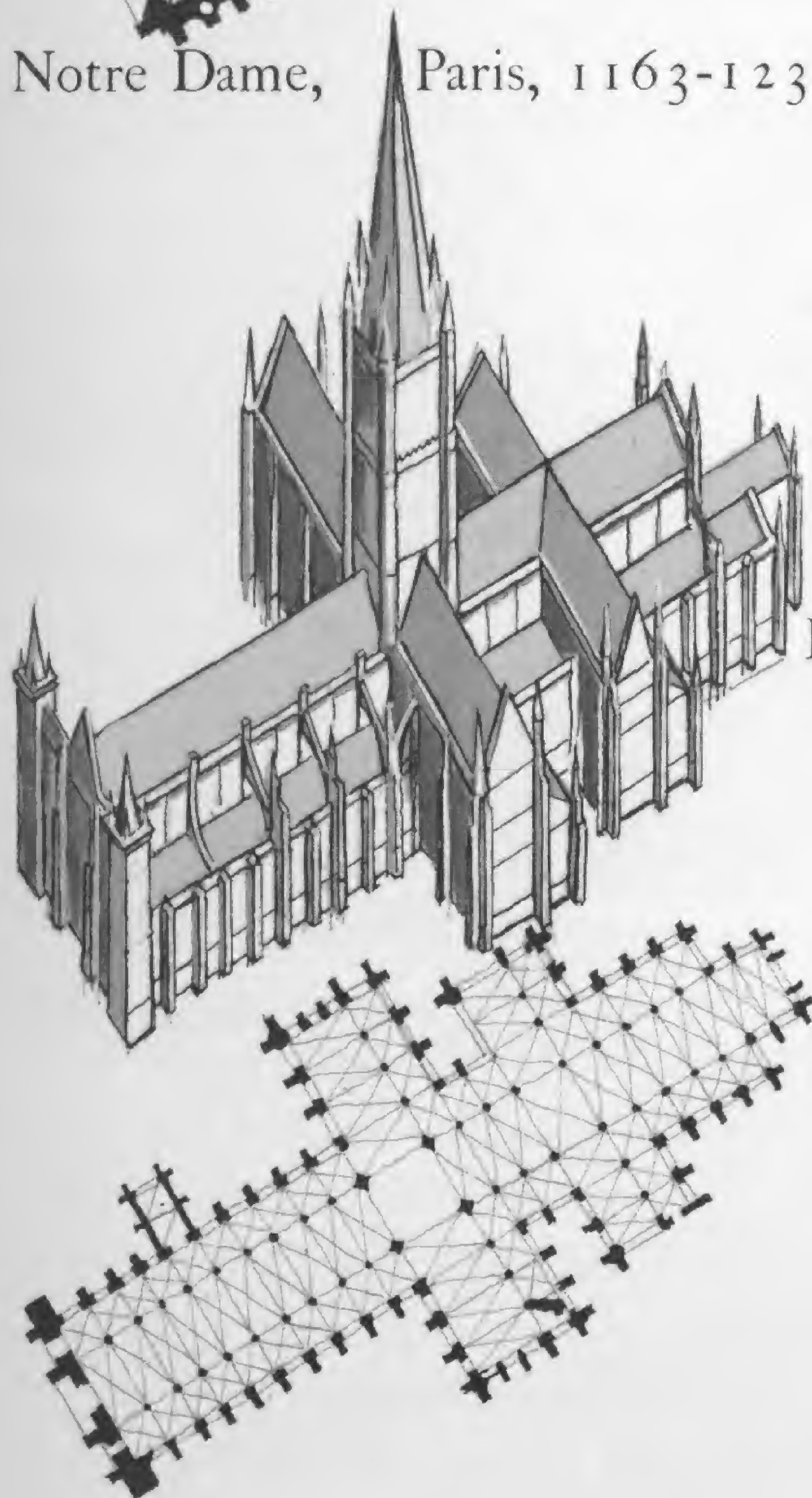
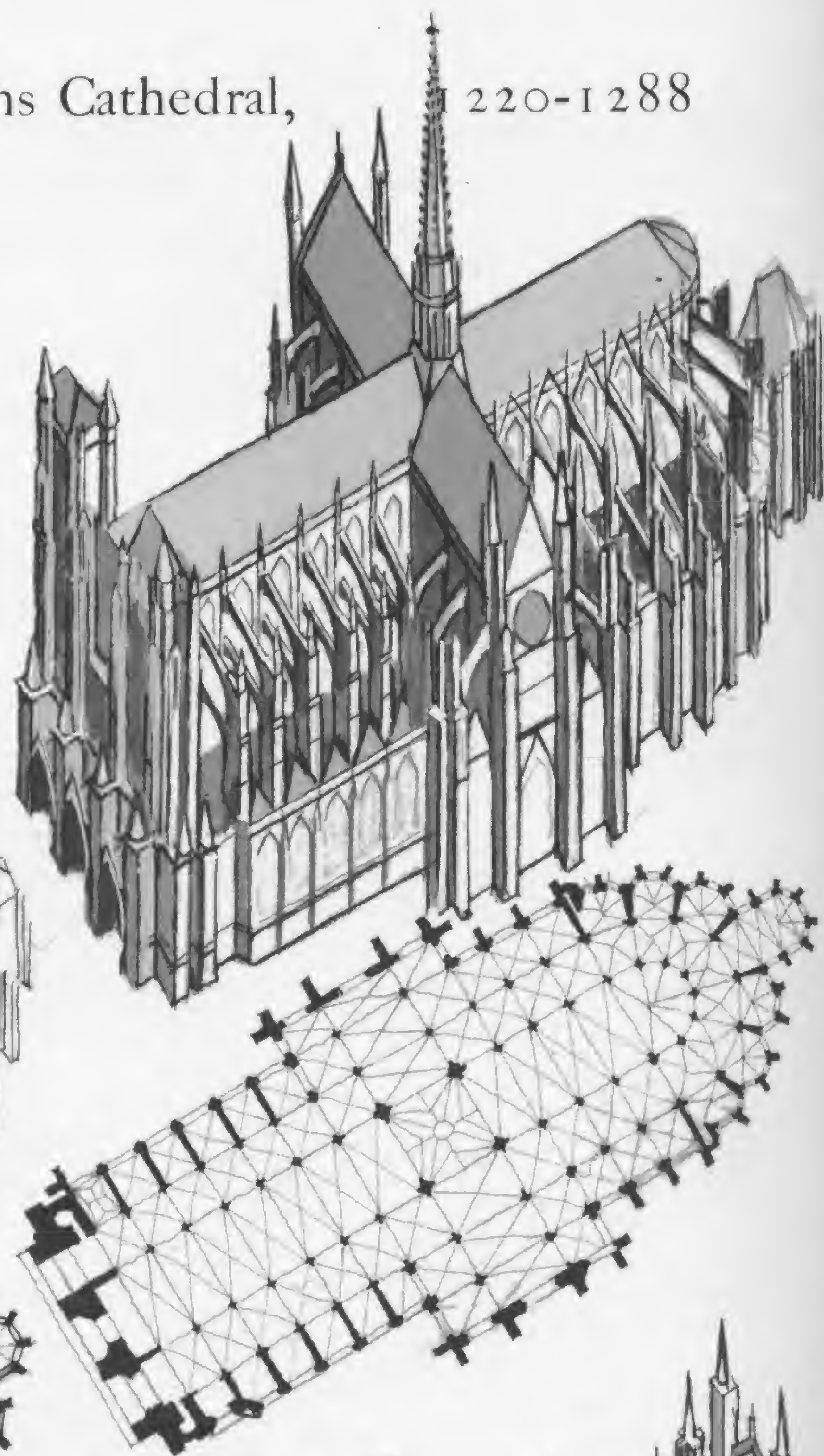


Notre Dame, Paris, 1163-1235

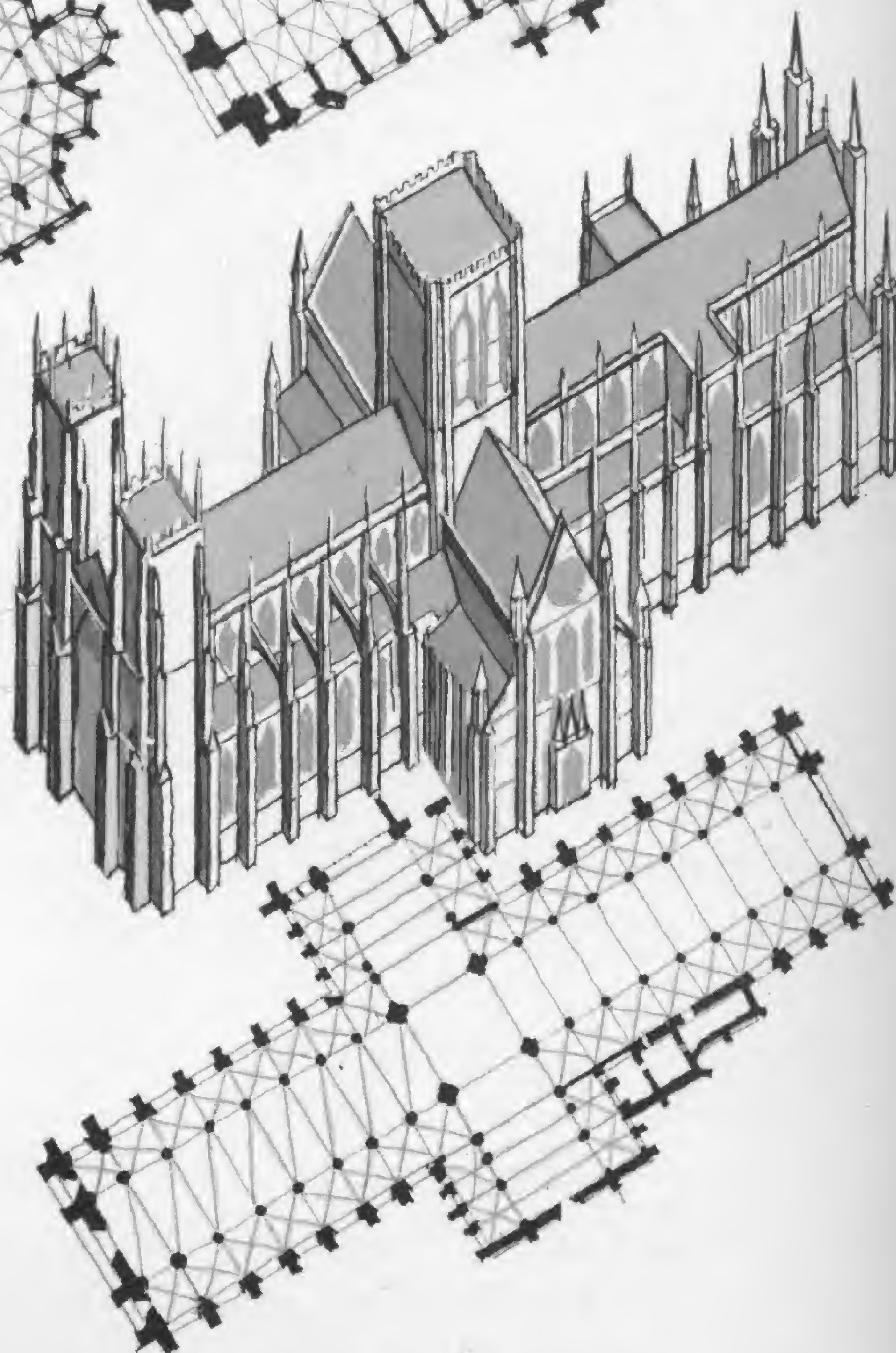


Marienkirche,
Lübeck, 1251-1310

GERMANY



Salisbury Cathedral, 1220-1258



York Cathedral, 1261-1324

ENGLAND

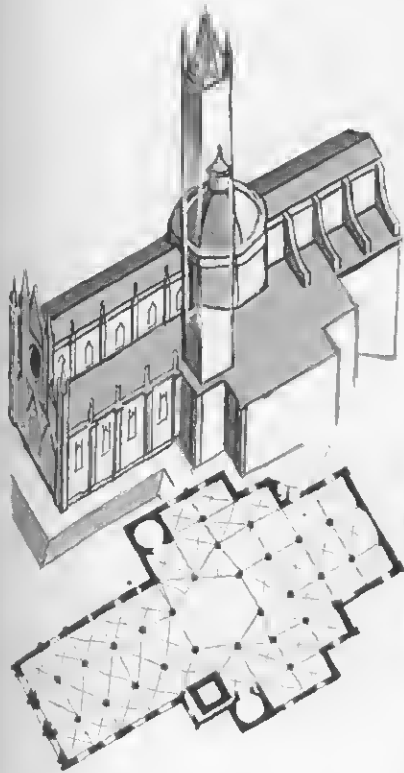
PLANS & ELEVATIONS

ITALY

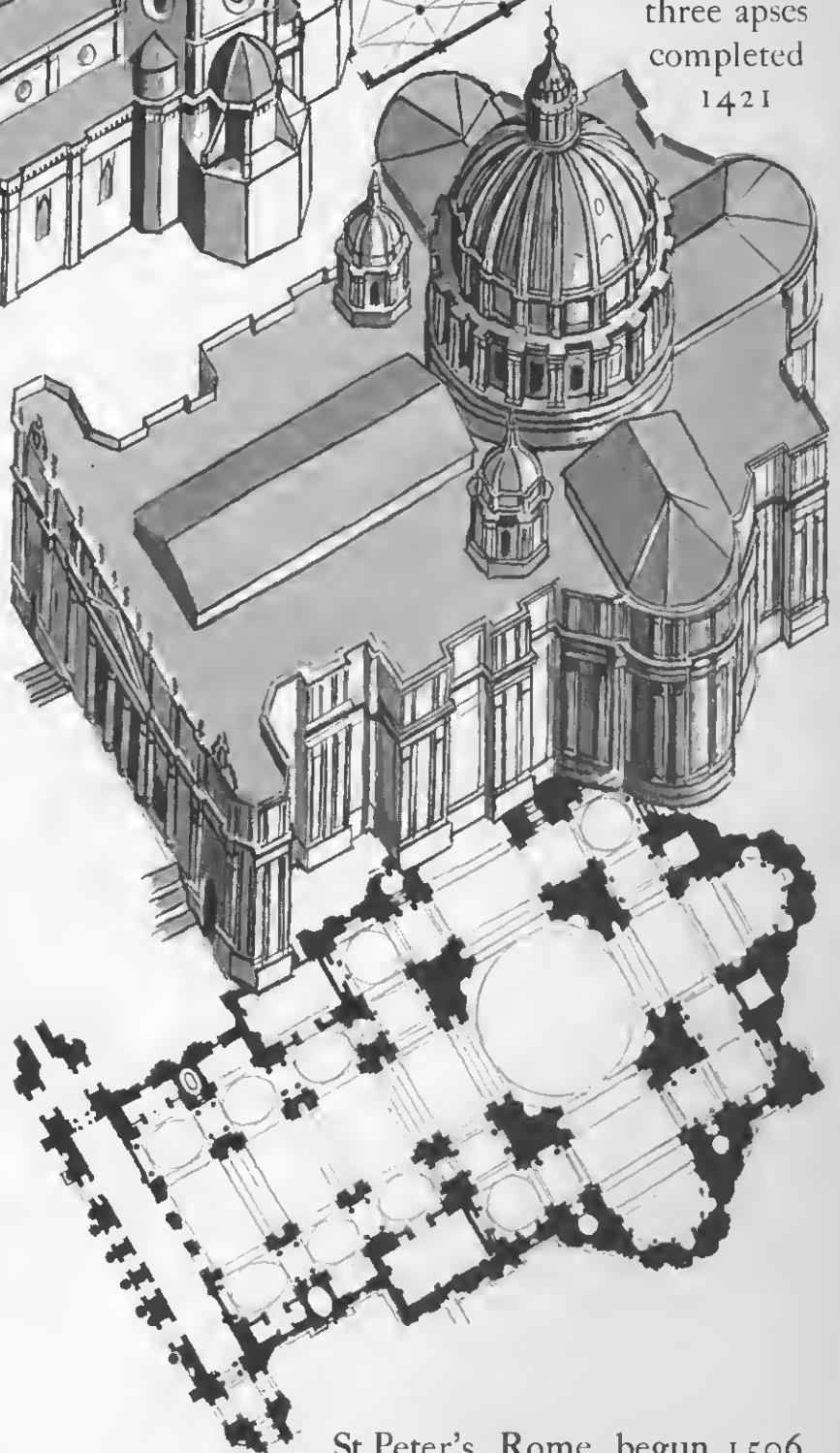
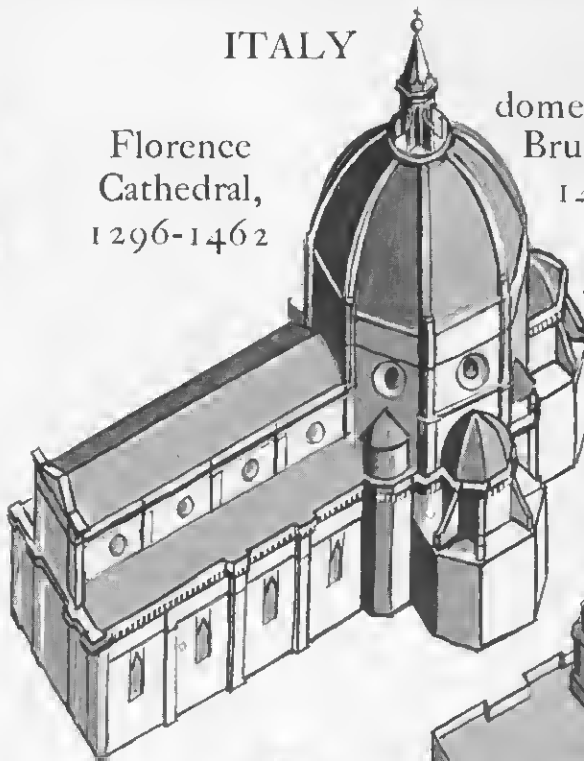
Florence Cathedral,
1296-1462

dome added by
Brunelleschi
1420-37

three apses
completed
1421



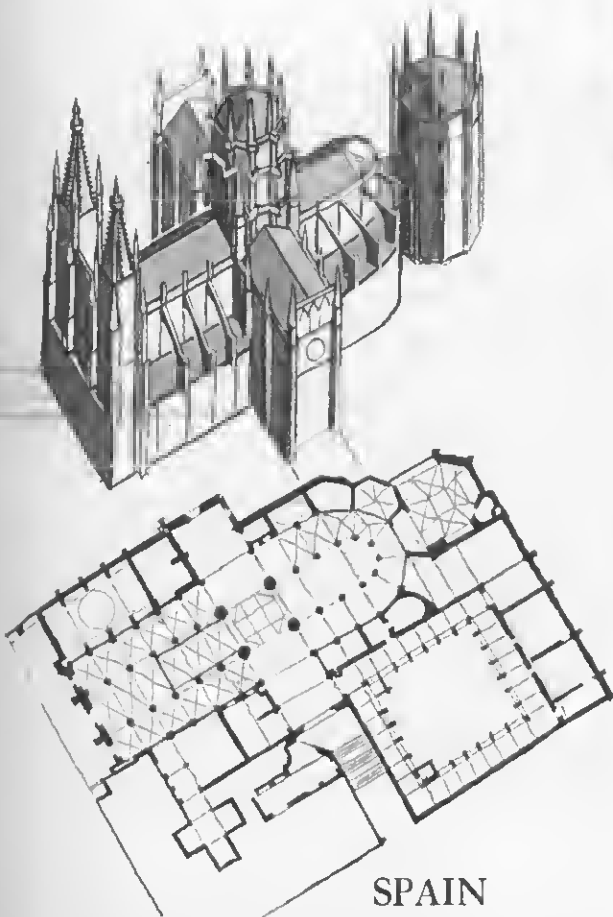
Siena Cathedral,
1245-1380



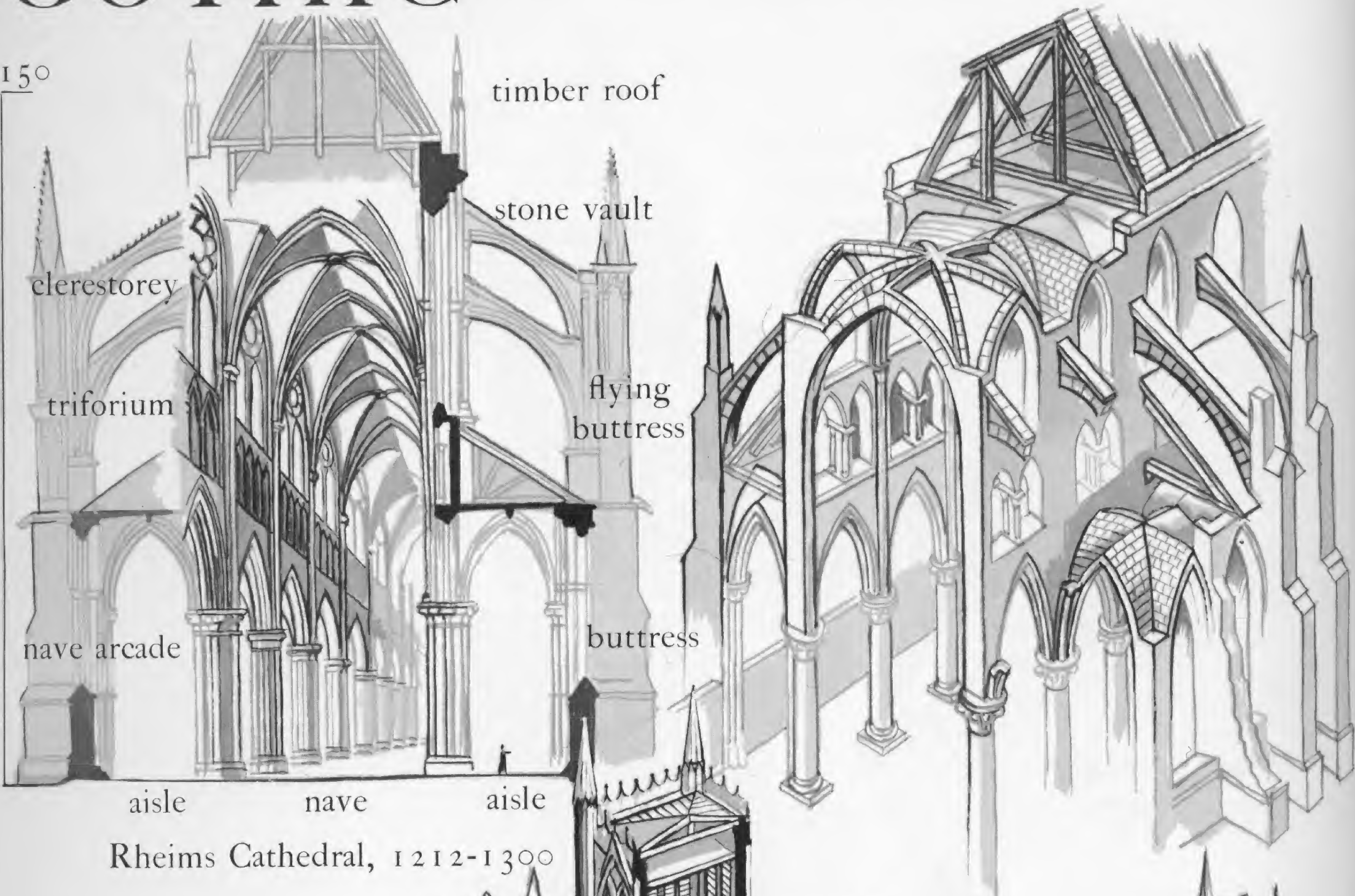
St Peter's, Rome, begun 1506

SPAIN

Burgos Cathedral, 1220-1500



GOTHIC



Rheims Cathedral, 1212-1300

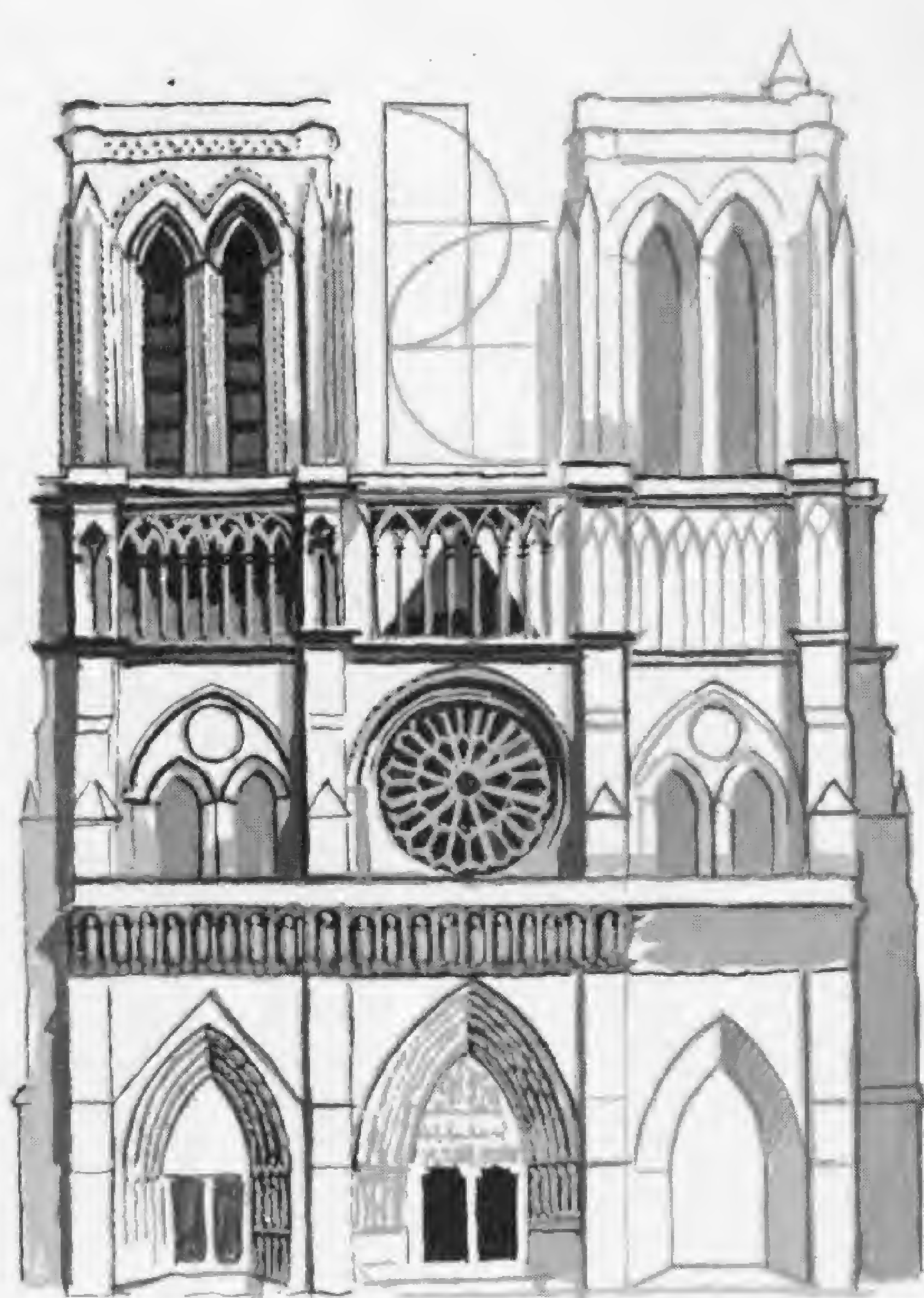


Lincoln Cathedral, 1220-1280

THE PARTS OF A CATHEDRAL



Laon Cathedral,
c. 1235



Notre Dame, Paris,
c. 1200-1250



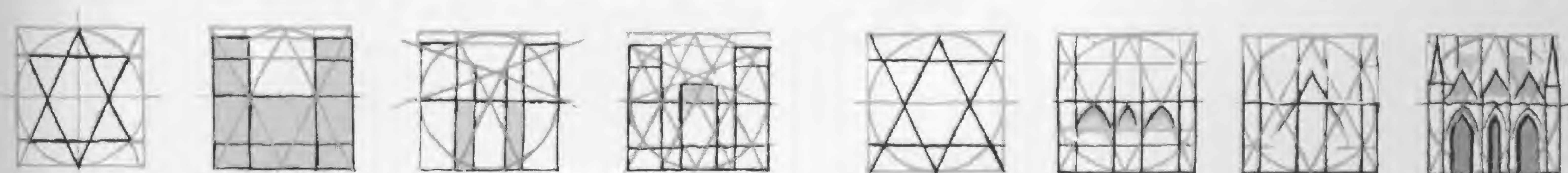
Rheims Cathedral,
c. 1255-c. 1290



Wells Cathedral, c. 1220-1242

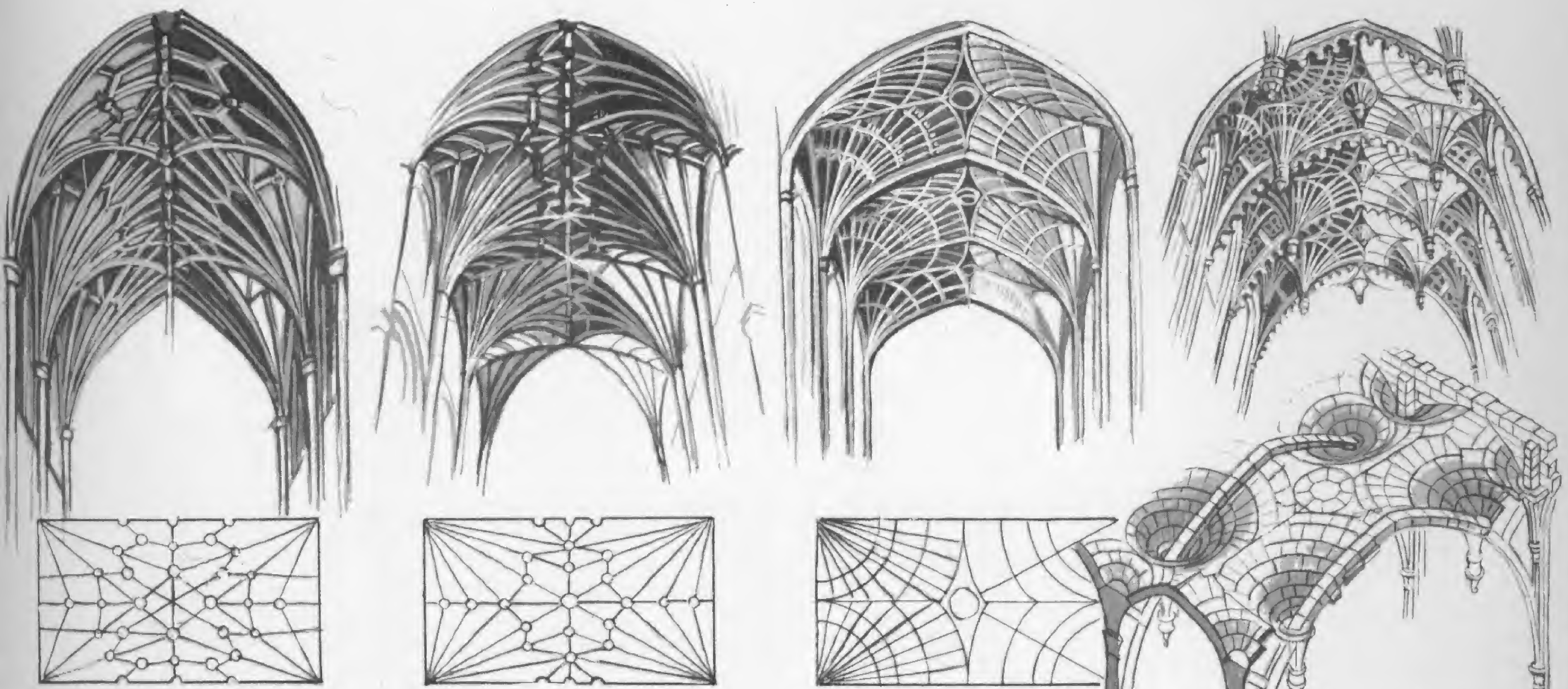


Peterborough Cathedral, c. 1235



THE WEST FRONT

ENGLAND, STONE VAULTING



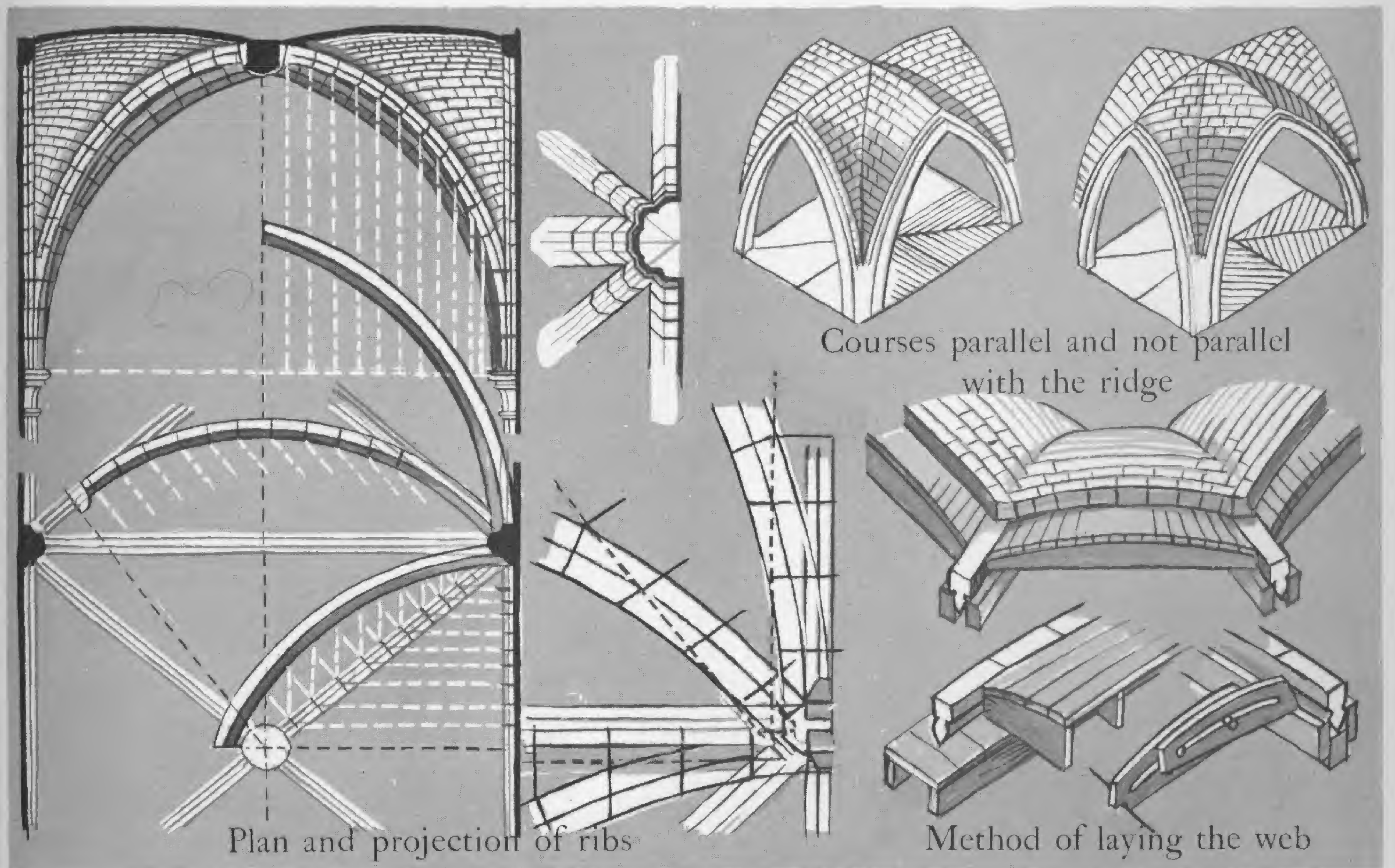
Introduction of liernes or small ribs
with shorter web courses

Winchester
Cathedral nave,
1371-1460

Norwich
Cathedral nave,
1463-1472

Fan vaults: all ribs of equal span
and the web carved from the same stone
King's College Chapel, Cambridge,
1446-1515

Henry VII's Chapel,
Westminster Abbey,
1502-1512



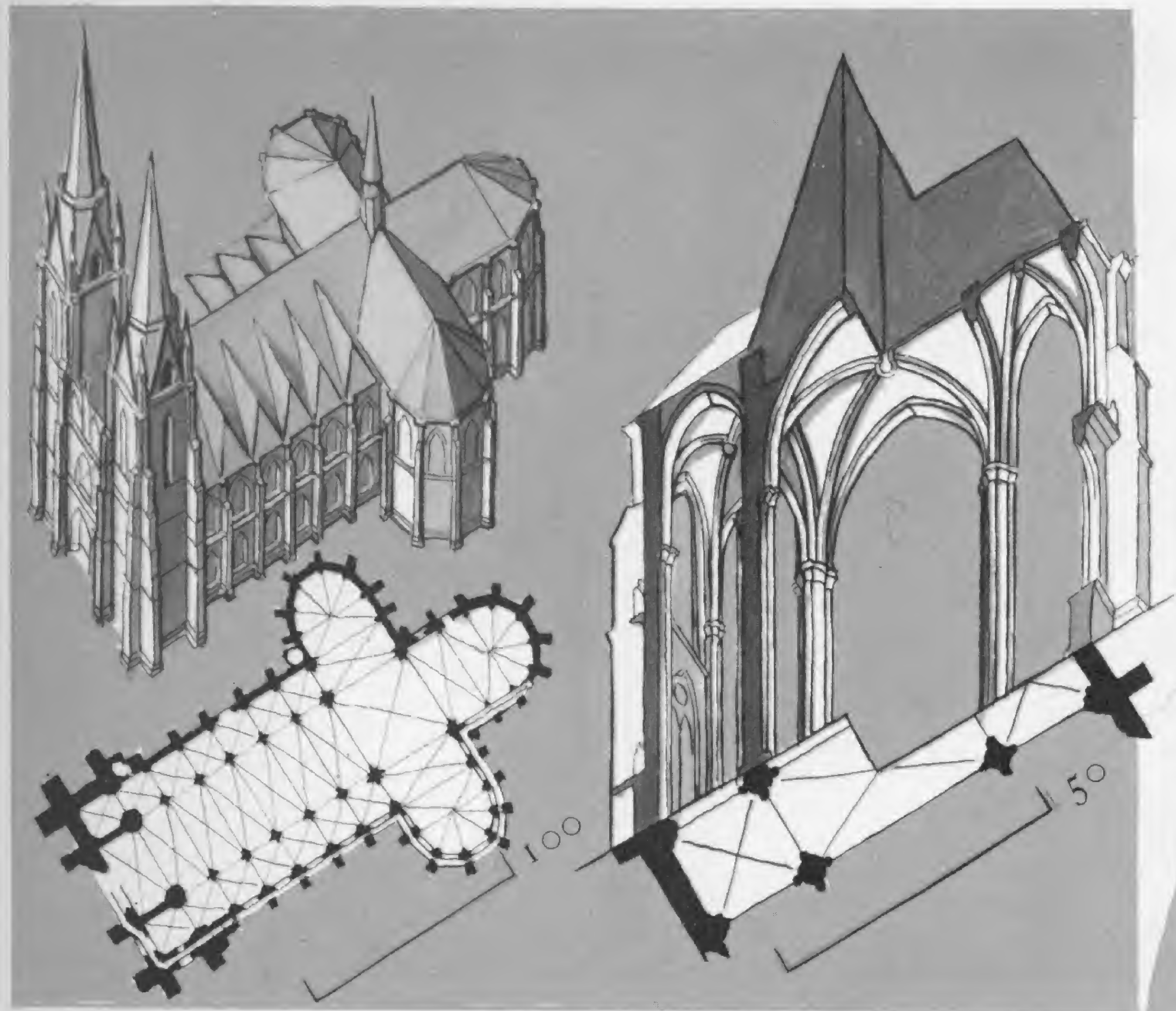
Courses parallel and not parallel
with the ridge

Plan and projection of ribs

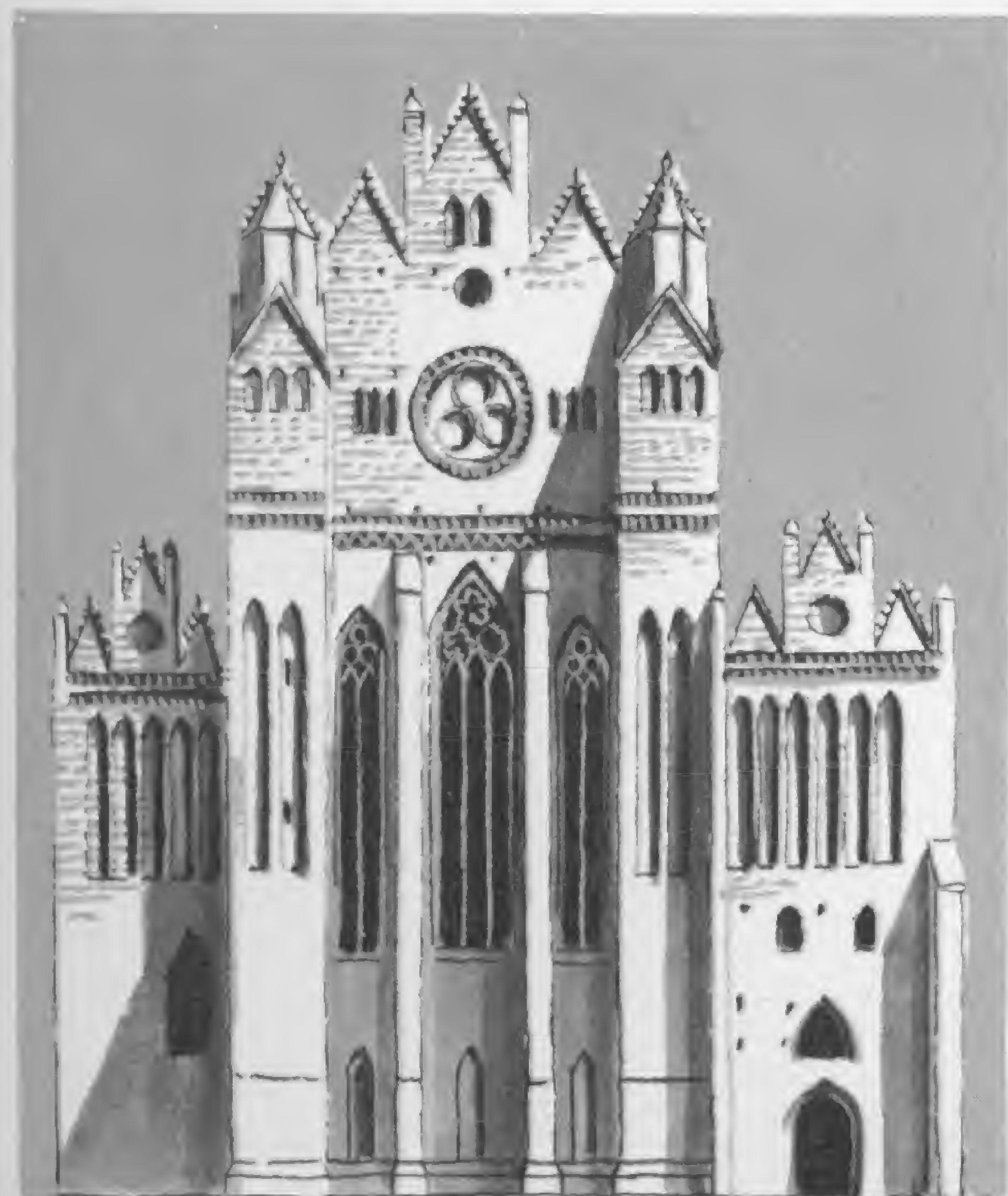
Method of laying the web

GOTHIC

385



S. Elizabeth, Marburg, c.1233-1283:
one of the many 'Hall' churches in North Germany,
having the nave and aisles of equal height



Chorin Abbey, c.1273-1334:
west front



Freiburg Cathedral, c.1268-1288:
west front

RENAISSANCE BAROQUE

1400 The Turks take Constantinople
1453 & block trade with the Orient: this leads to maritime discoveries

1500

Columbus 1492

Magellan 1519-22

Portuguese

Spanish

1600

Holy Roman Empire

Rome

The Empire of _____ and his son

Spain Spain united 1497 1519—Charles V—1556—Philip II of Spain—1598

Italy Florence: the Renaissance Rome: temporal power of the Popes Venice: trade lost

France Franco-Spanish rivalry in Italy 1515—Francis I—1547 Italian influence

Holland 1568 Revolt of the

England 1485—Henry VII—1509—Henry VIII—1547—1558—Elizabeth I—1603

War of the Roses Italian influence Mary I marries Philip II of Spain

Germany head of some 300 states 1483—Martin Luther—1546

1483 Invention of printing

1480 Mainz, c. 1450 brought the revival and spread of Latin and Greek texts

1499

1469

1470

1467

1466

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1464

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1414

1413

1412

1411

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1409

1408

1407

1406

1405

1404

1403

1402

1401

1400

Protestant

Catholic

Greek

Moslem

the Counter-Reformation

Trent

Rome

Internal Reformation of the Roman Church at the Council of Trent 1545-63, aided by

1499-S. Ignatius Loyola-1556 founded the Society of Jesus

empyrean

planets

earth

The Medieval universe, haunted by the law and order of the Roman Empire

earth

sun

Concerning the Revolutions of the Heavenly Spheres

Nuremberg, 1543

1473—Copernicus—1547

On the Infinite Universe & its Worlds

1584

1564—Bruno—1600

THE RENAISSANCE

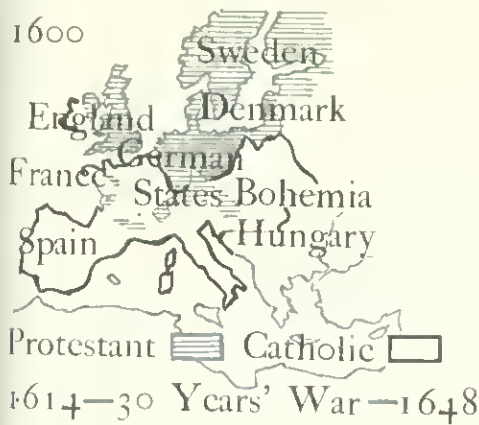
The Renaissance (Florence) High Renaissance (Rome) Mannerism

1400 Renaissance churches were centralized and designed on the drawing-board. They were inspired by classical architecture, as interpreted by Vitruvius (above all, by Roman temples, arches, domes & the Five Orders (pp. 116-117)), & obeyed the canon

1500 of the Divine Proportions (pp. 118-119). The increasingly dramatic movements of High Renaissance and Mannerist buildings became, especially in the 'theatrical' churches of the Counter-Reformation, an interplay of forces. (This required the drawing of

1600

INTRODUCTION



English (solid black box)
Dutch (dotted box)
Spanish (white box)
Portuguese (solid grey box)



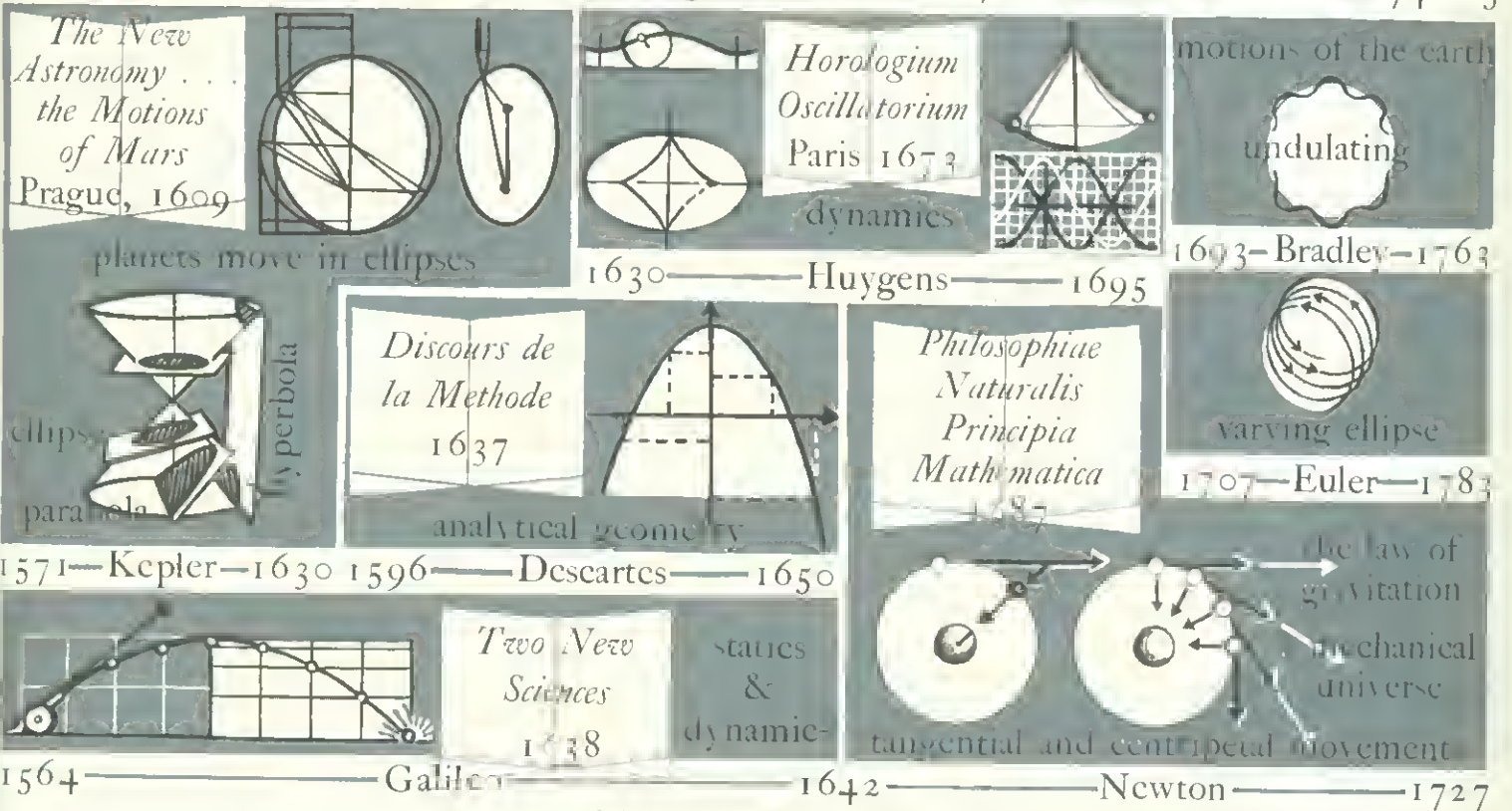
Conflict for colonies and overseas trade

to new Atlantic seaports. Domination of Spain in Italy ends 1710

1610-Age of the Cardinals-1643-Ascension of France: Louis XIV-1715-Louis XV-1774
Netherlands from Spain 1648 Republic of the United Provinces

James I-1625-Charles I-1649-1660-Charles II-1685-1689 1702-Anne-14-George I-1727
Divine Right of Kings Commonwealth James II Colonial Expansion

Impoverished by the 30 Years' War Kingdom of Prussia 1701 Frederick the Great 1740-85



THE BAROQUE

Baroque

Rococo

1600

three-dimensional elevations and curved details by means of projective geometry, which had been developed by the new science of dynamics.)

This Baroque style was finally resolved into the lighter curves of the Rococo.

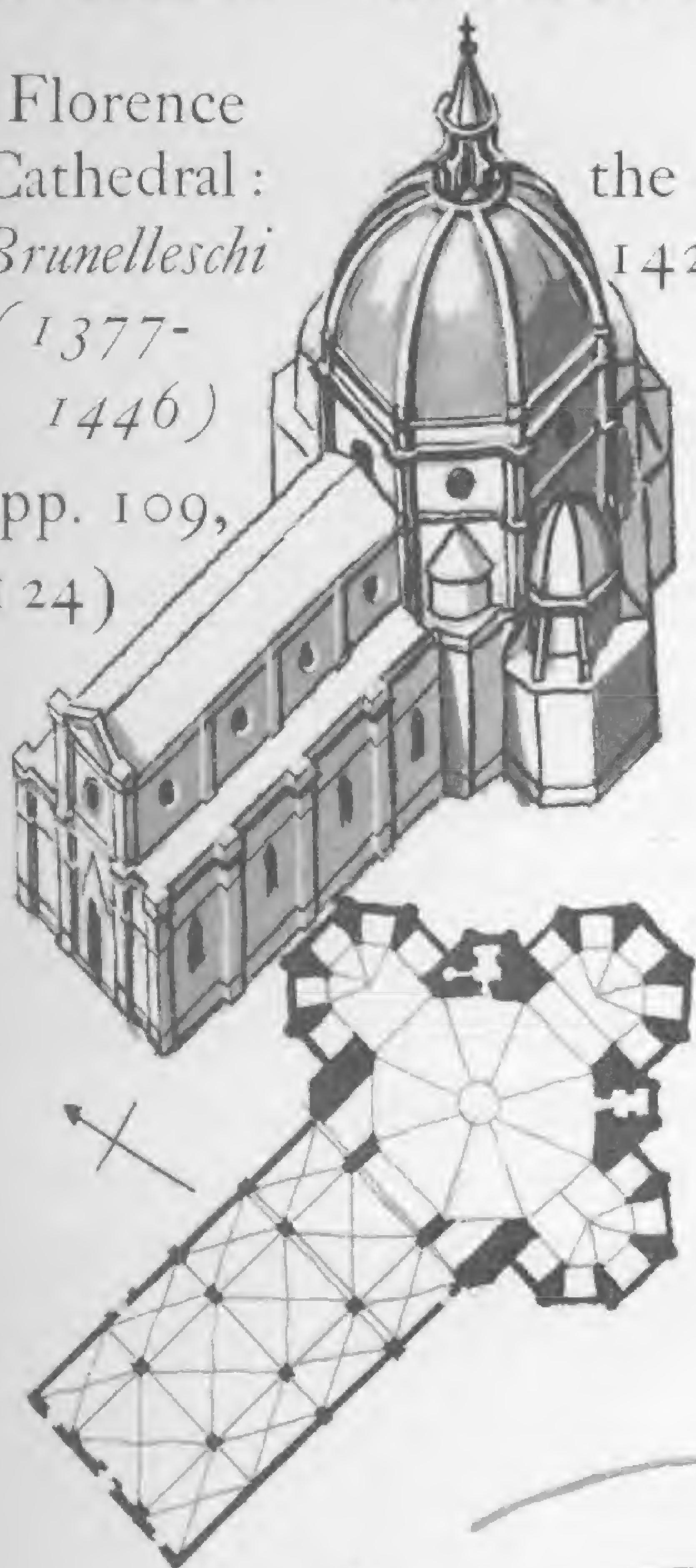
1700 1750

The architecture of each European country was a reaction to that of Italy, modified by its own native characteristics.

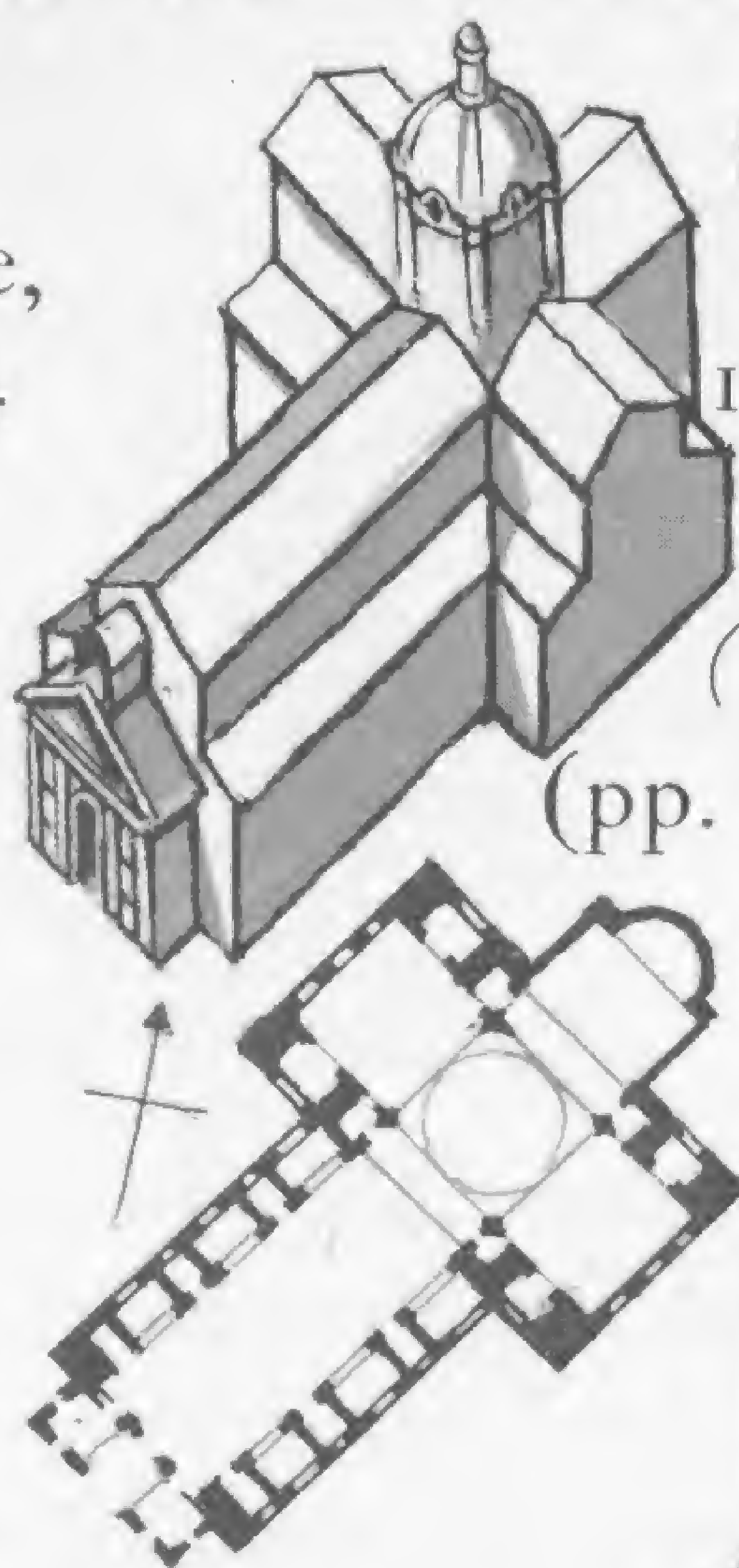
France (pp.130-133), Germany & Austria (pp.134-135), Spain (pp.136-137), England (pp.138-159).

RENAISSANCE - BAROQUE

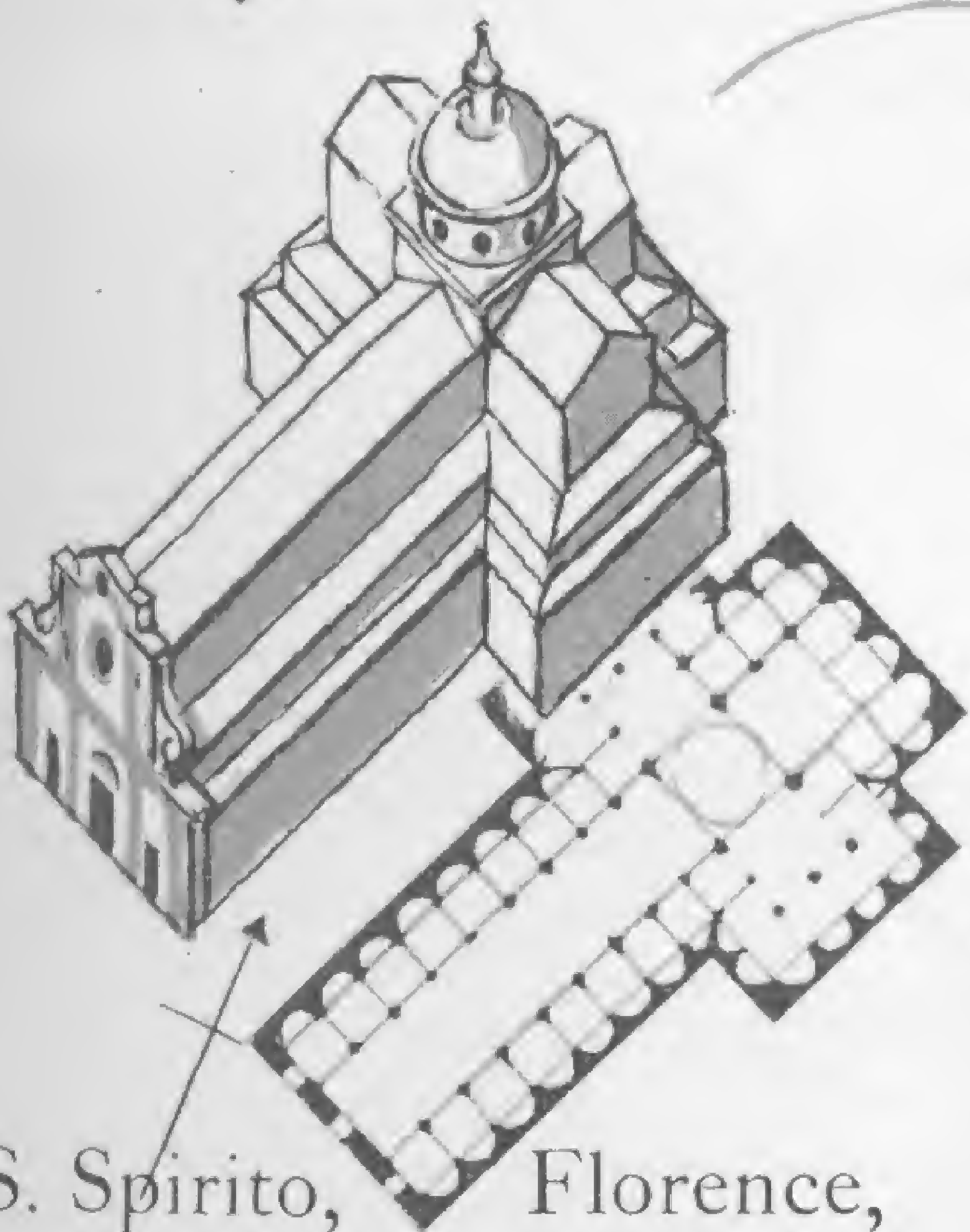
Florence
Cathedral:
Brunelleschi
(1377-
1446)
(pp. 109,
124)



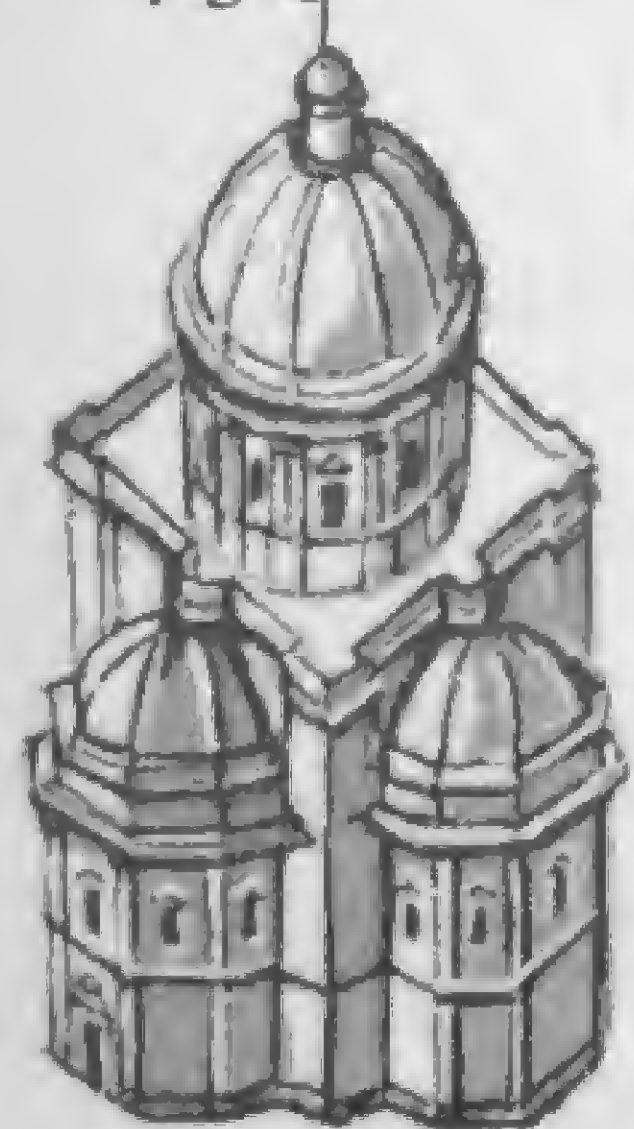
the dome,
1420-34



S. Andrea,
Mantua,
1472-1512
Alberti
(1404-72)
(pp. 120, 122)



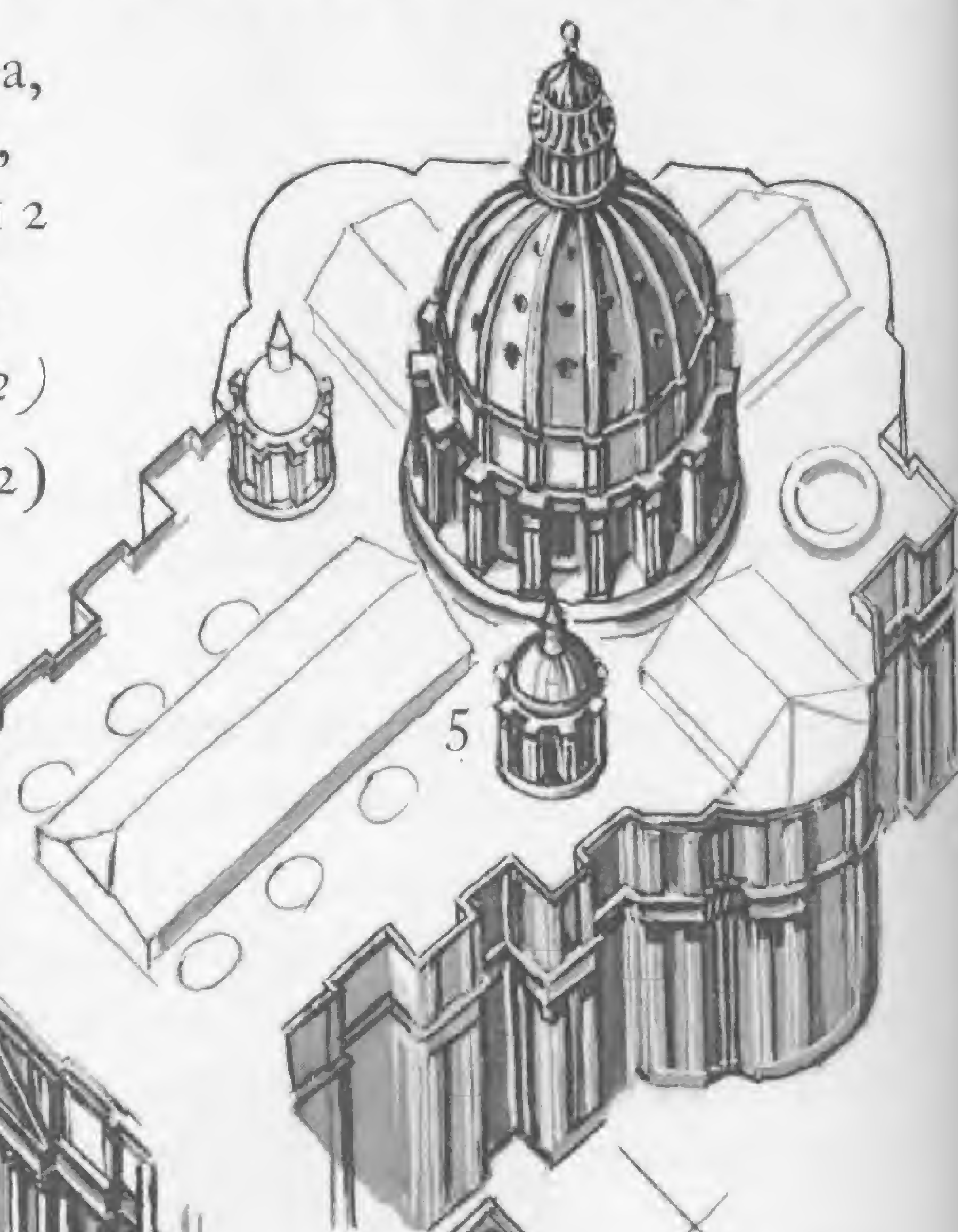
S. Spirito, Florence,
1435 *Brunelleschi*
(p. 122)



S. Maria della Consolaz-
ione, 1508, *Bramante*
& *Cola di Caprarola*

Pope Julius II (1503-13)
had the old basilican
church pulled down (p. 70),
and successive plans were
made for the new church:

- 1 *Bramante* (1444-1514)
1506
- 2 *Raphael* (1483-1520)
1515-20
- 3 *Sangallo the Younger*
(1485-1546)
1539
- 4 *Michelangelo* (1474-1564)
1546-64
also designed the dome,
completed 1585-90
by *Giacomo della Porta*
(1541-1604)
and *Domenico Fontana*
(1543-1607);
- 5 side cupolas added 1564,
by *Vignola* (1507-73)
- 6 *Carlo Maderna*
(1556-1629) lengthened
nave to form a Latin cross
& added the façade 1606-12

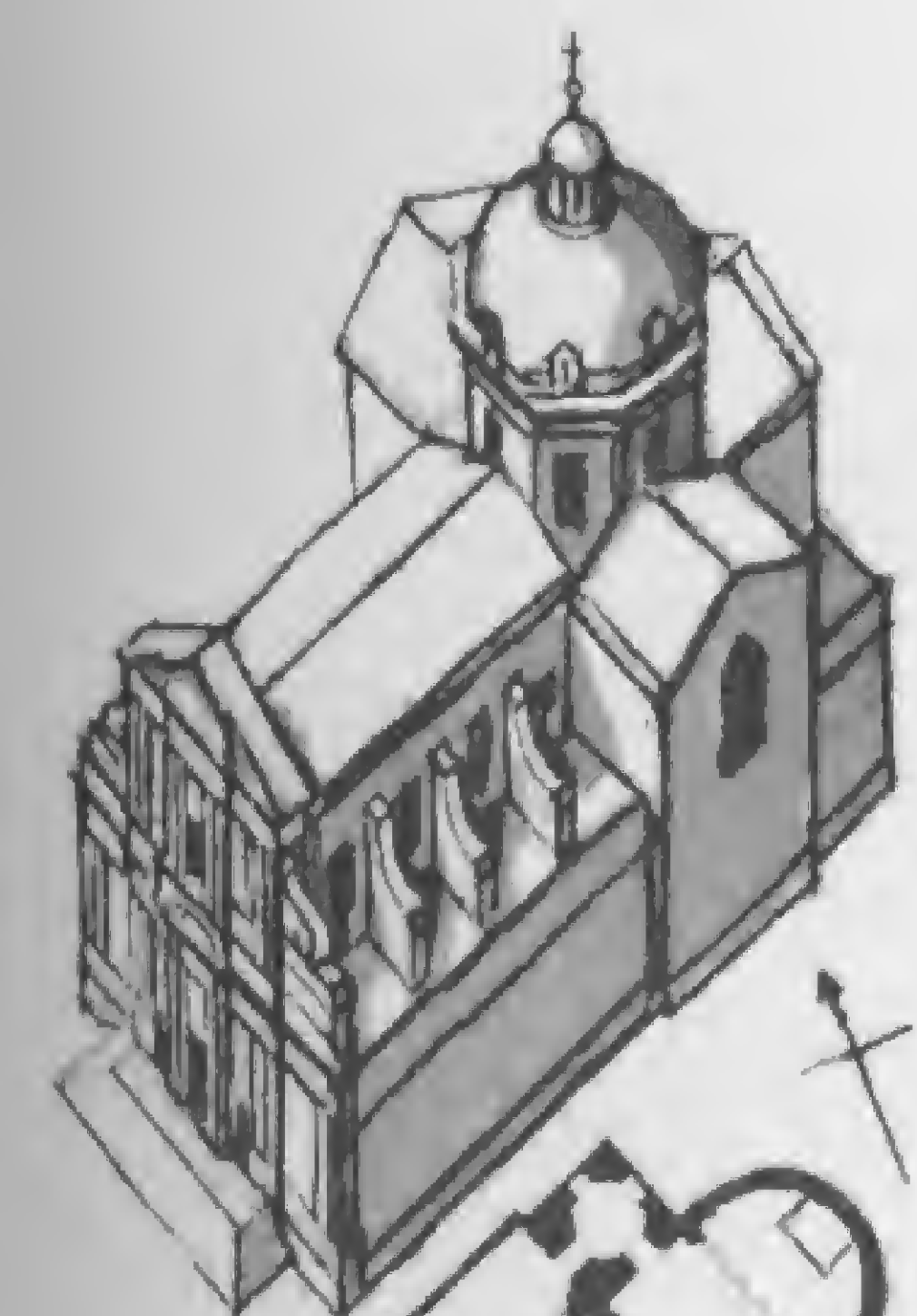


St Peter's, Rome, 1506-1612 (pp. 93, 124)

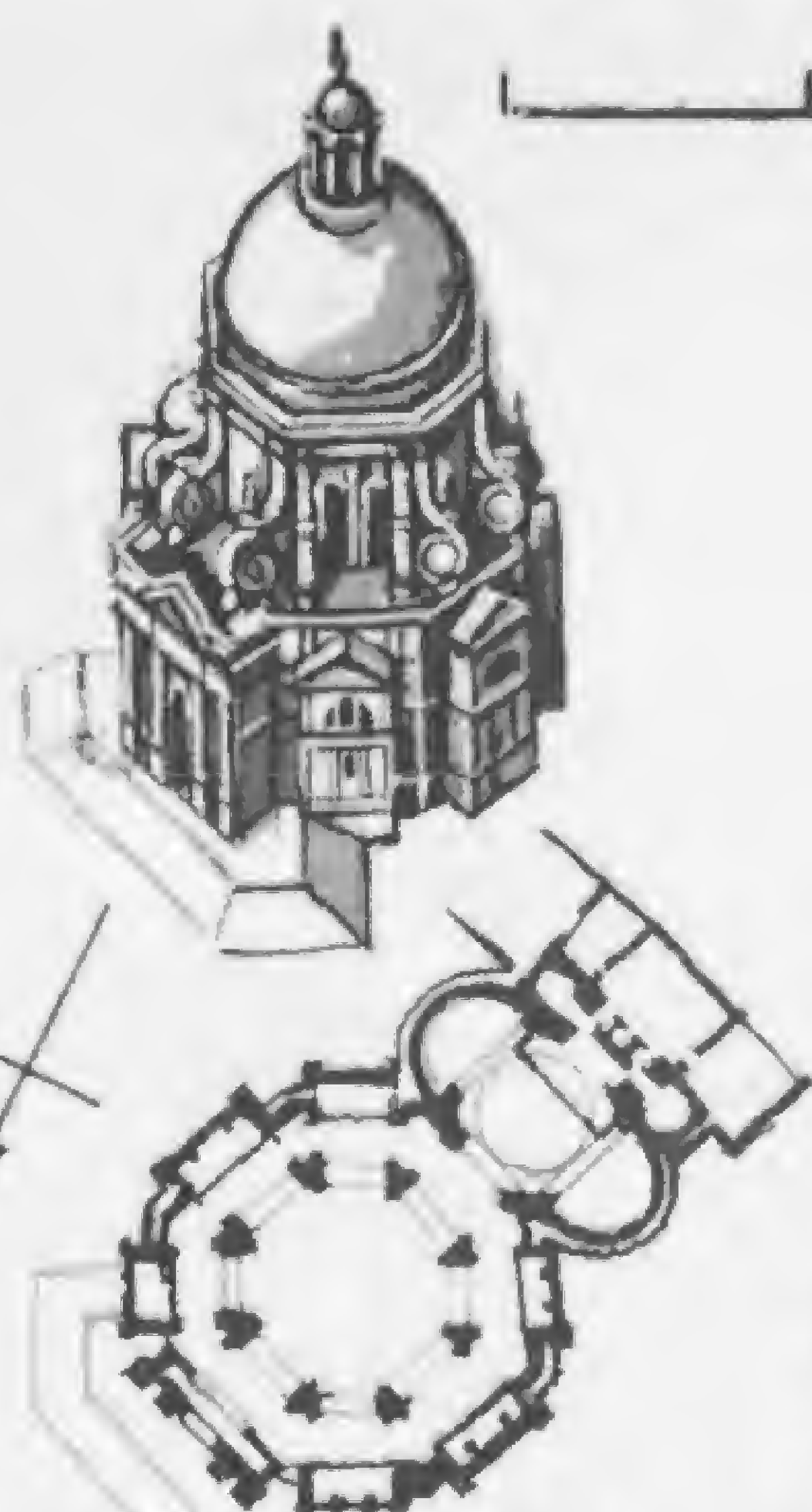
PLANS & ELEVATIONS

plans and elevations
to the same scale

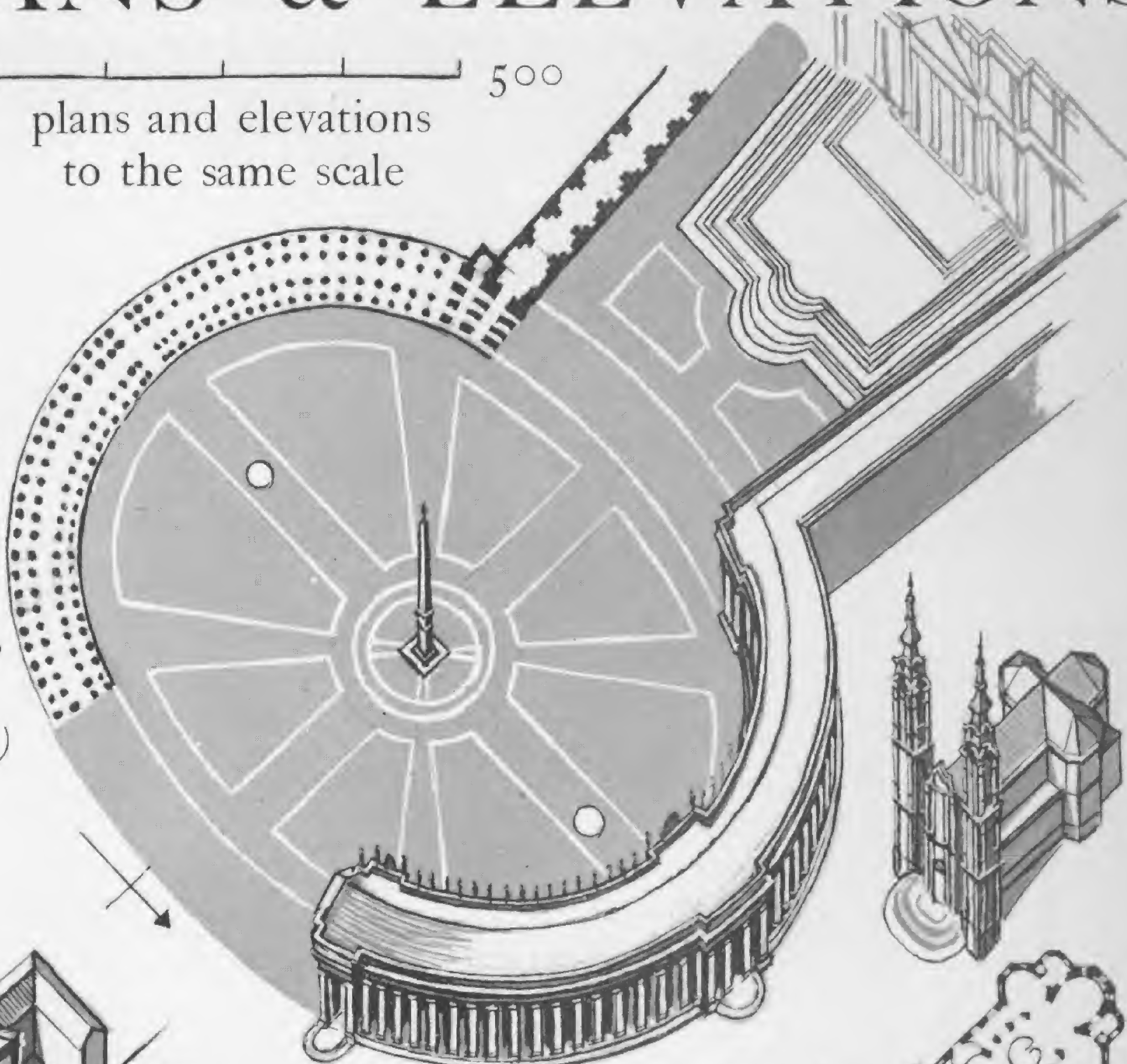
500



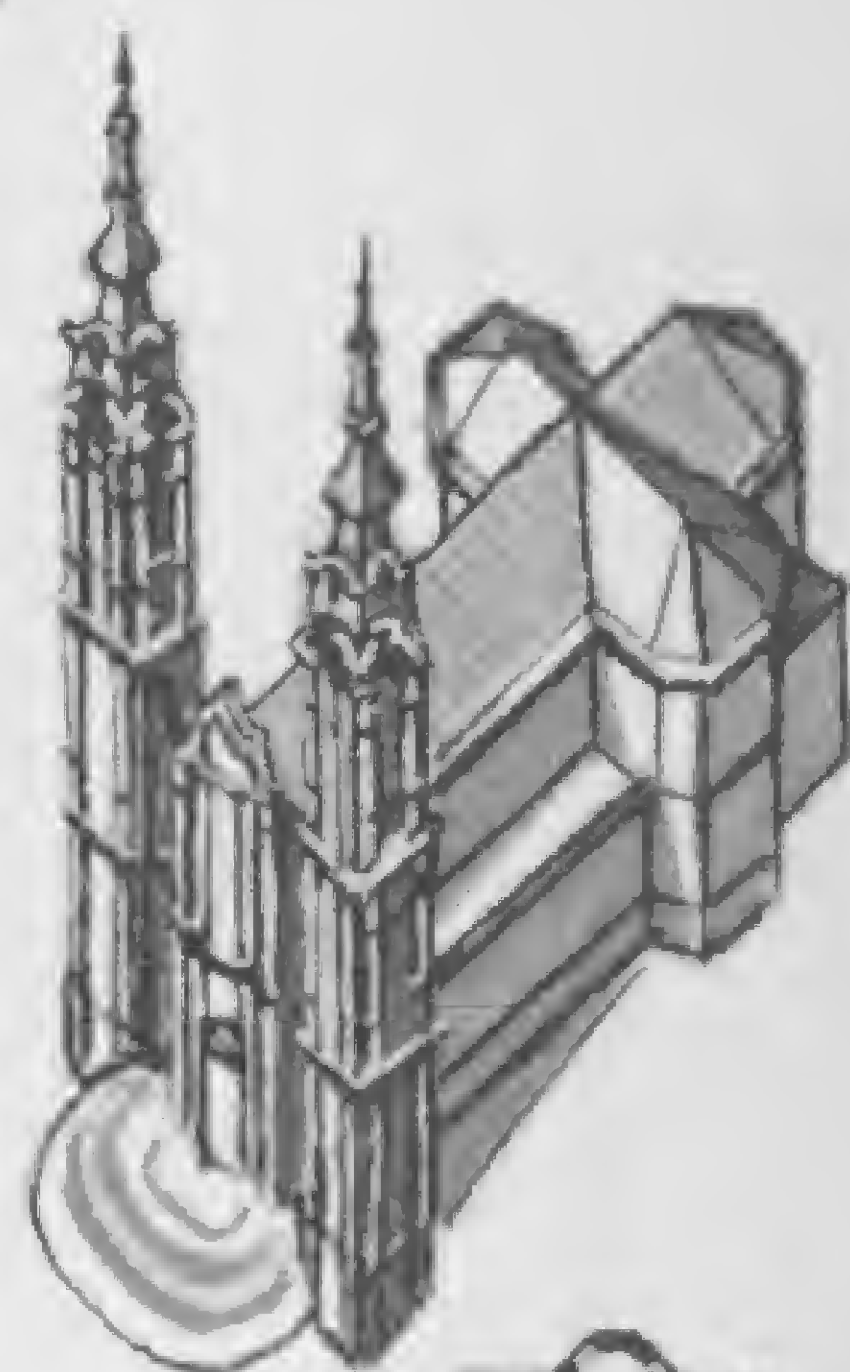
The Gesù,
Rome,
1568-75
Vignola
(1507-73)
(pp. 120,
122)



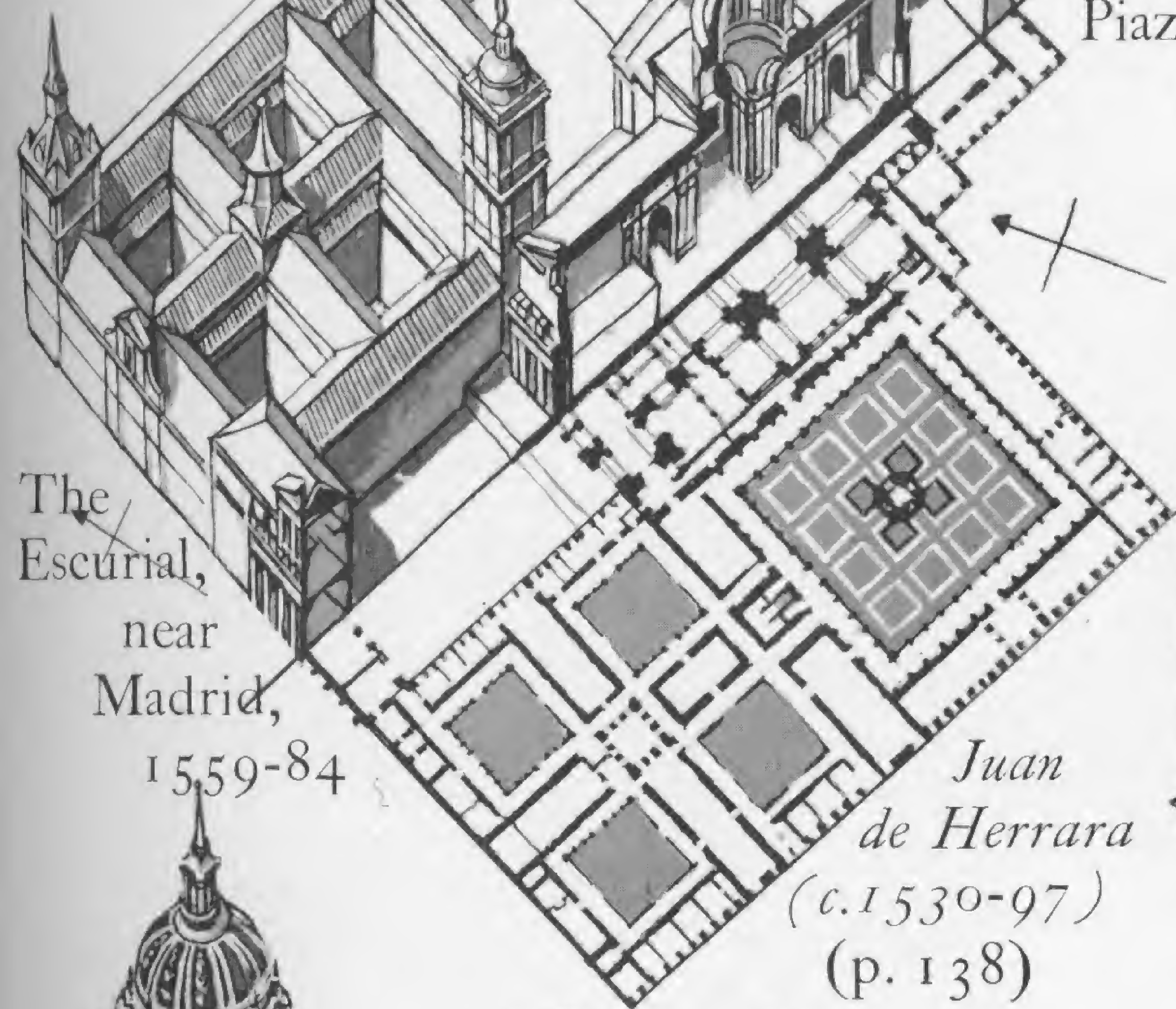
S. Maria della Salute,
Venice, 1632
Longhena (1604-75)



Piazza, St Peter's, Rome, 1655-67
Bernini (1589-1680)



Vierzehnheiligen,
S. Germany,
1744-72 *Neumann*
(1687-1753)
(p. 137)

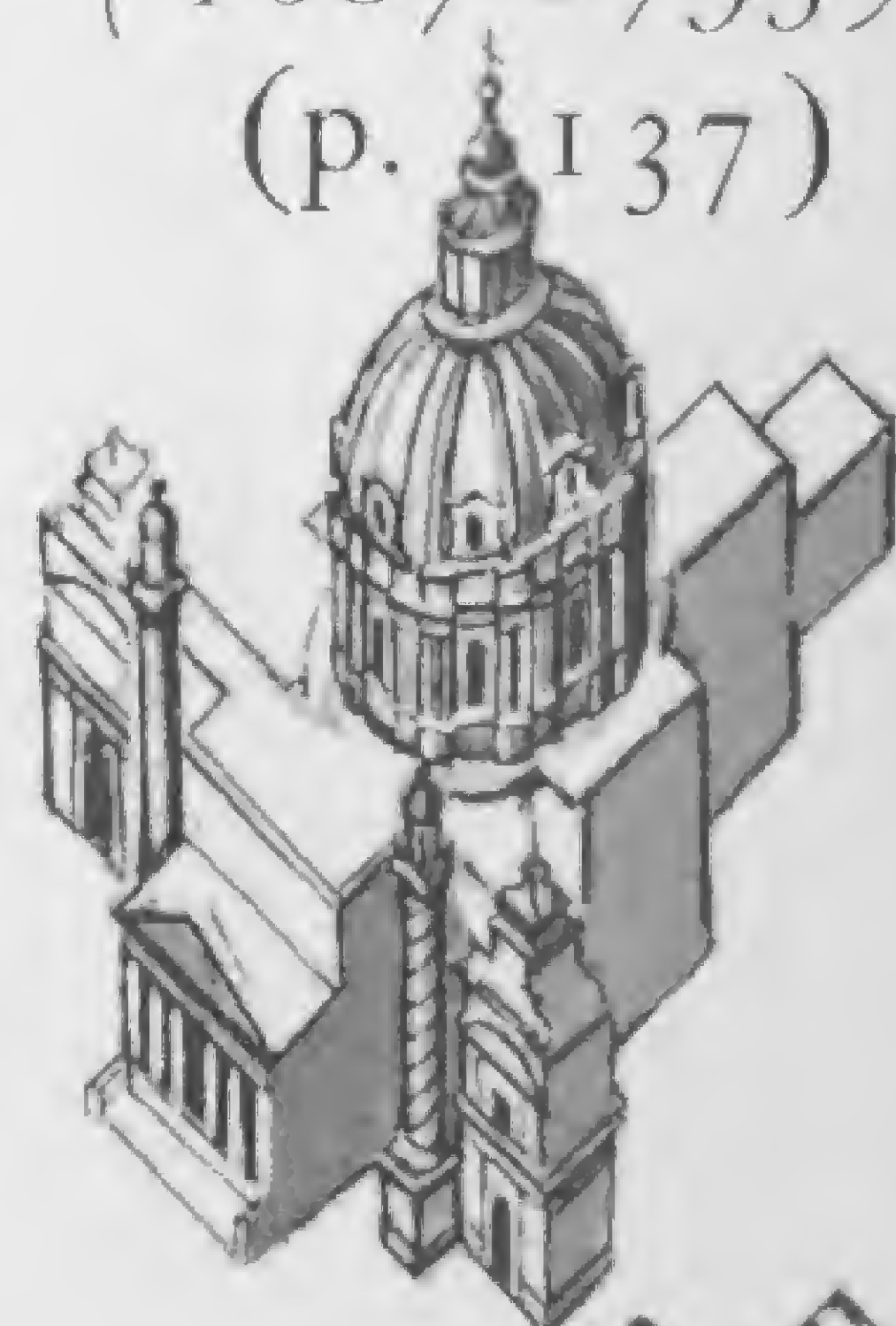


The
Escorial,
near
Madrid,
1559-84

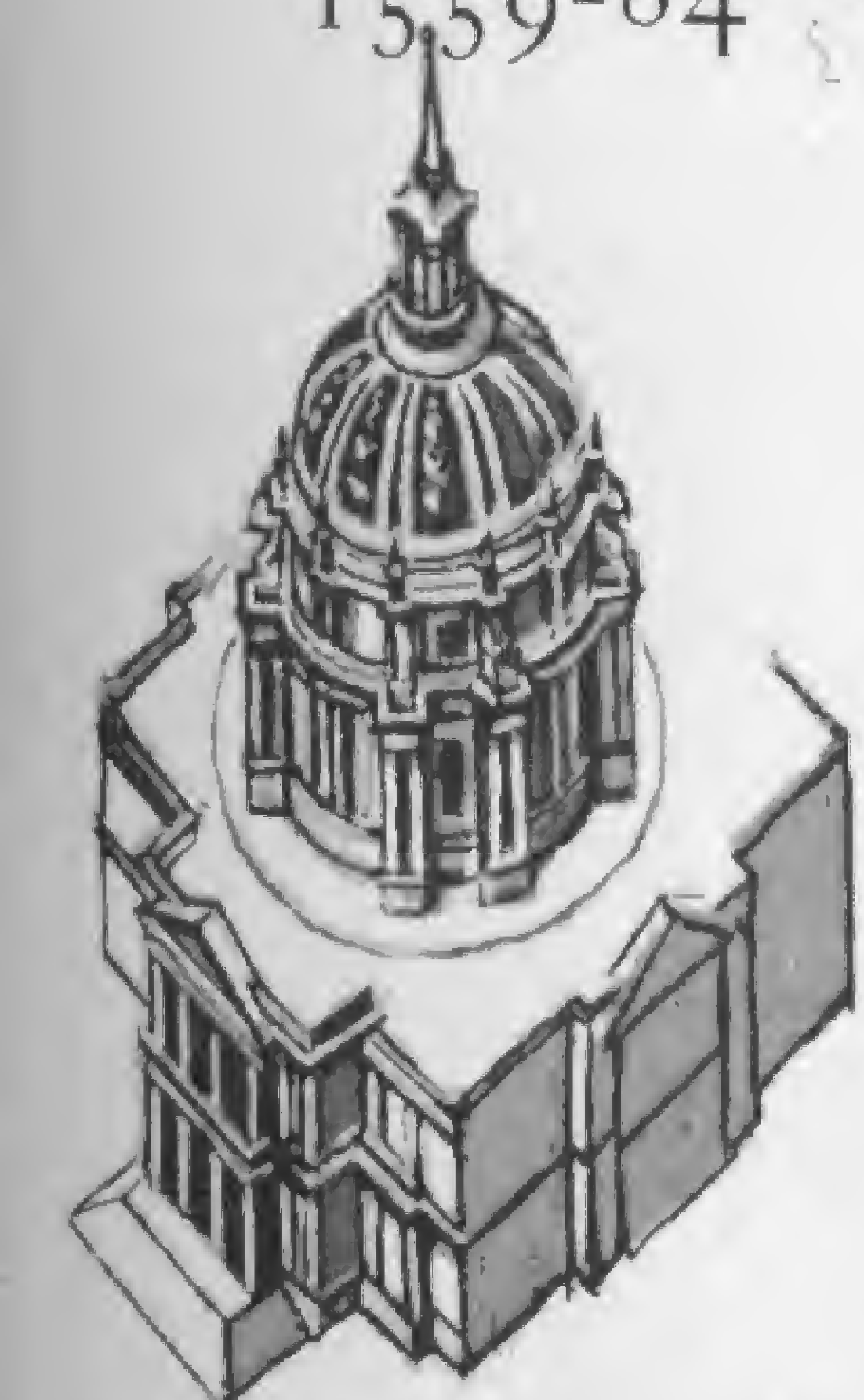
*Juan
de Herrera*
(c.1530-97)
(p. 138)



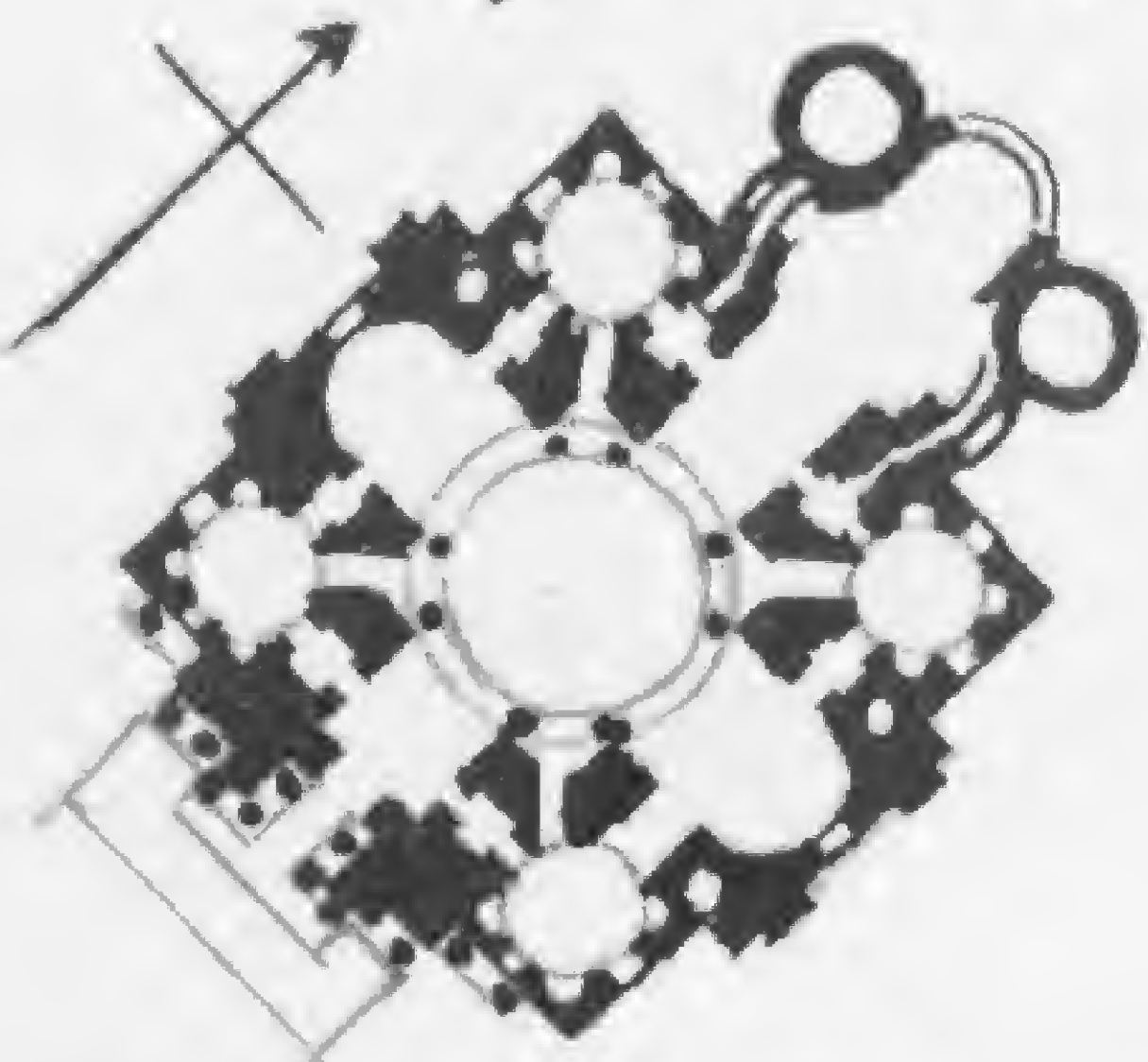
St Paul's Cathedral, London,
1675-1710
Sir Christopher Wren (1631-1723)
(pp. 144-145)



Karlskirche,
Vienna,
1716-29
J. B. Fischer
von Erlach
(1656-1725)



The Dome of the Invalides, Paris,
1693-1706
(1646-1708) *J. H. Mansart*
(pp. 125, 131)



RENAISSANCE - BAROQUE

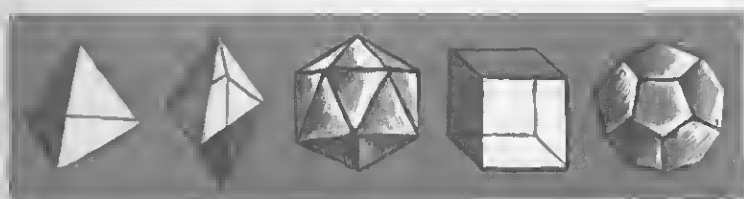
Sources of Italian architectural theory:

1. The study of Roman buildings.
2. The Platonic-Aristotelian description of God and the Universe as a perfect circle.
3. The Pythagorean, and Medieval, idea of Man as the microcosm of the Universe (the macrocosm).
4. The linking of Geometry and Music, two of the Seven Liberal Arts:

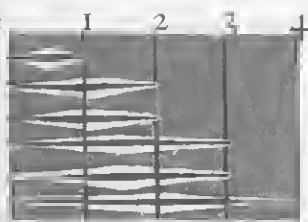
'Geometry makes visible the musical consonances' (Boethius, *De Musica*, c.500).
In Florence Cosimo de Medici (1389-1462) founded the Platonic Academy.



gives an account of the creation and geometrical form of the universe. He represents the four basic elements and the cosmos as:

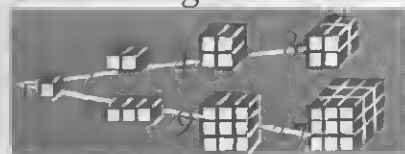


these 'Platonic' bodies are the 5 regular solids. The elements of the cosmos, as well as its soul-substance & its motion, were created proportionate to musical ratios based on Pythagoras (582-c.507 B.C.) He 'regarded numbers as the elements of all things and the whole heaven as a numerical scale' (Aristotle), & found that tones could be measured by striking cords proportionate in length.



1:2 octave
2:3 fifth
3:4 fourth

Plato gives the 'Harmonic' scale as:



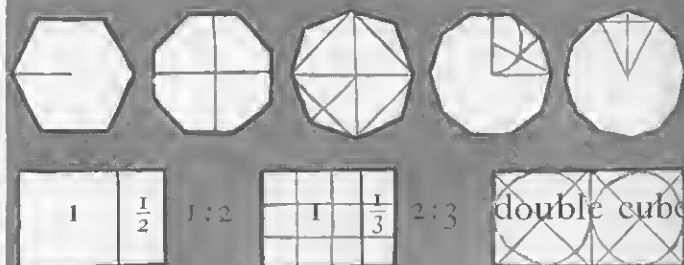
which contain the musical consonances
1:2, 2:3, 3:4.

For Renaissance architect-theorists, churches based upon these axioms, would be microcosms of the universe of God:

'... the little temples we make ought to resemble this very great one' (Palladio).

Marcus Vitruvius Pollio
The Ten Books on Architecture
Roman architect & engineer 1st century B.C.

Vitruvius
(edited by Fra Giocondo)
Venice, 1511

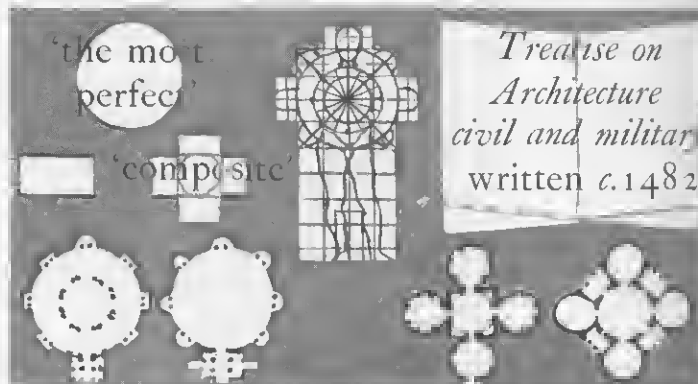


Ideal plans for churches (VII, 4)

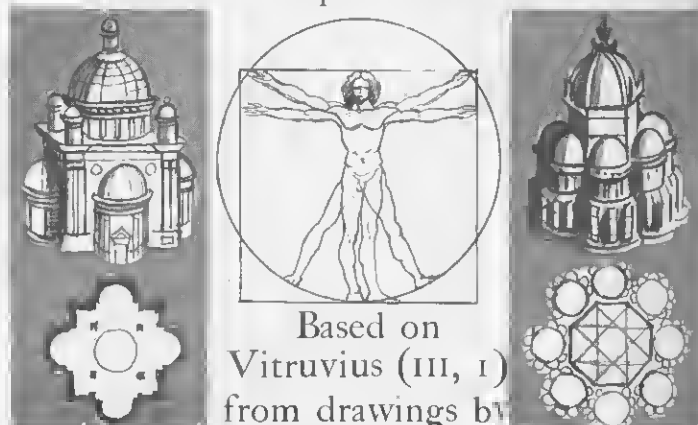
'Of all these numbers. . .
(1:2 octave, *diapason*;
2:3 fifth, *sesquialtera*;
3:4 fourth, *diatessaron*)
... the architects make
very convenient use' (IX, 5)

Ten Books on Architecture
Florence 1485
England 1726

1404—Leon Battista Alberti—1472
Florentine architect and theorist

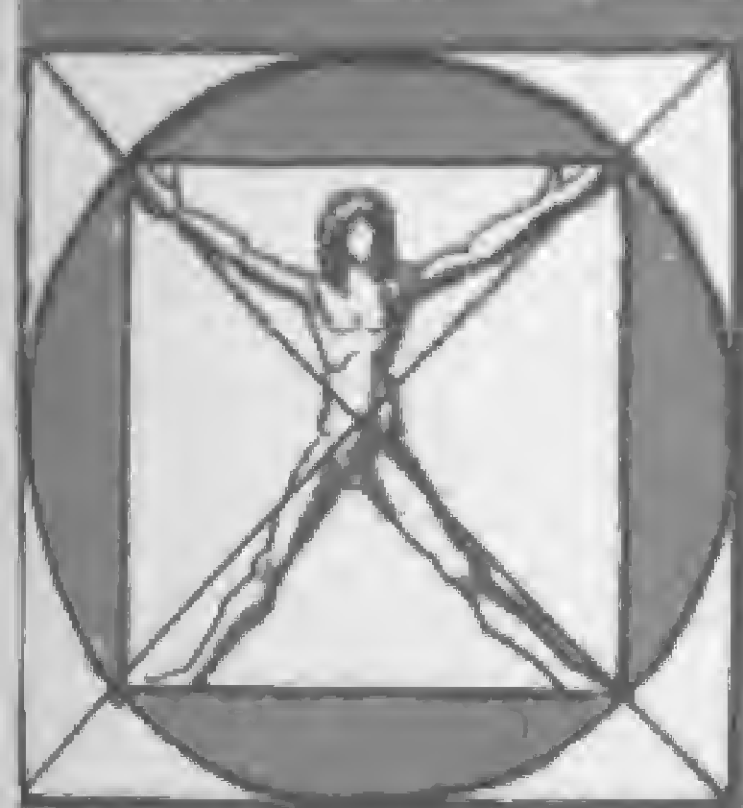


1439—Francesco di Giorgio—1502
Siennese sculptor and architect



1452—Leonardo da Vinci—1519

THE DIVINE PROPORTIONS



Vitruvius
(edited by
Cesarino),
Como, 1521

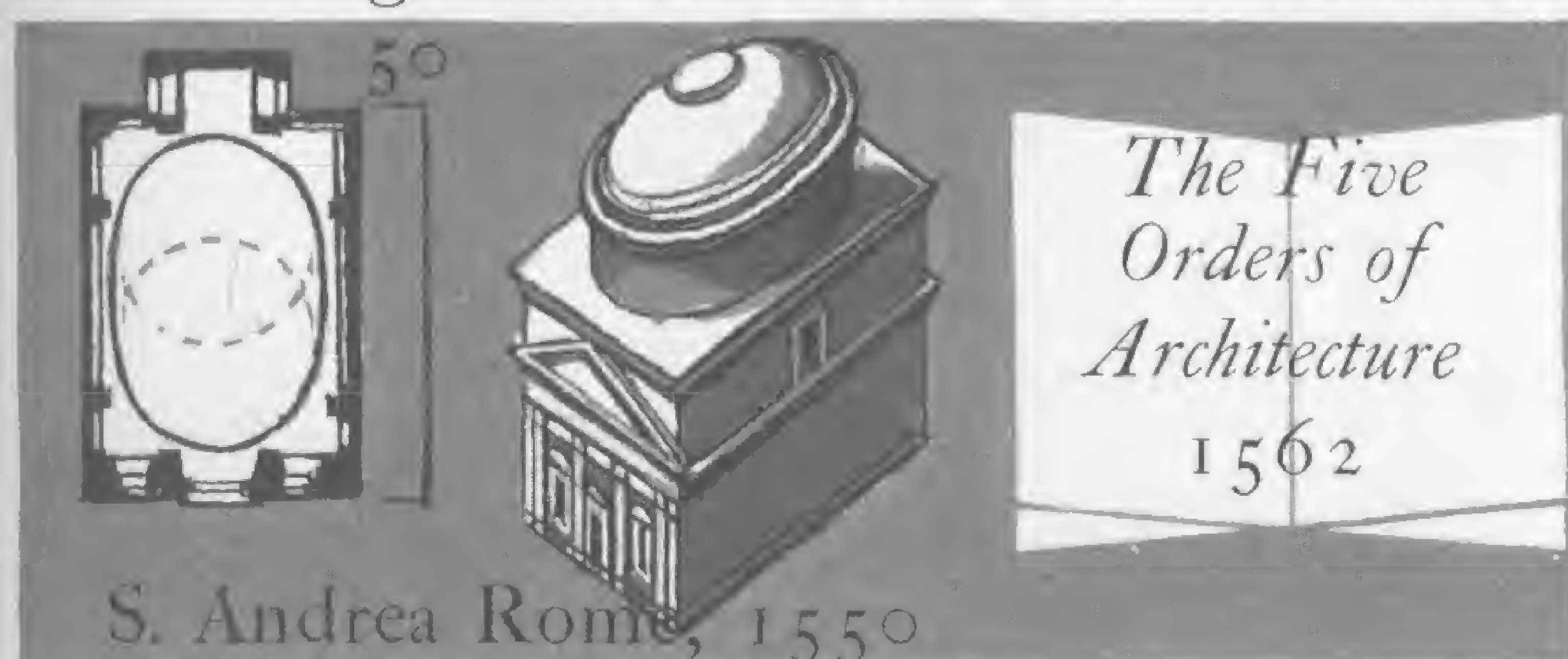
Vitruvius
(edited by Barbaro,
illustrated by Palladio),
Venice, 1556

*Architecture de Vitruve
ou Art de bien bâtir
mis en français*
Jean Martin 1546

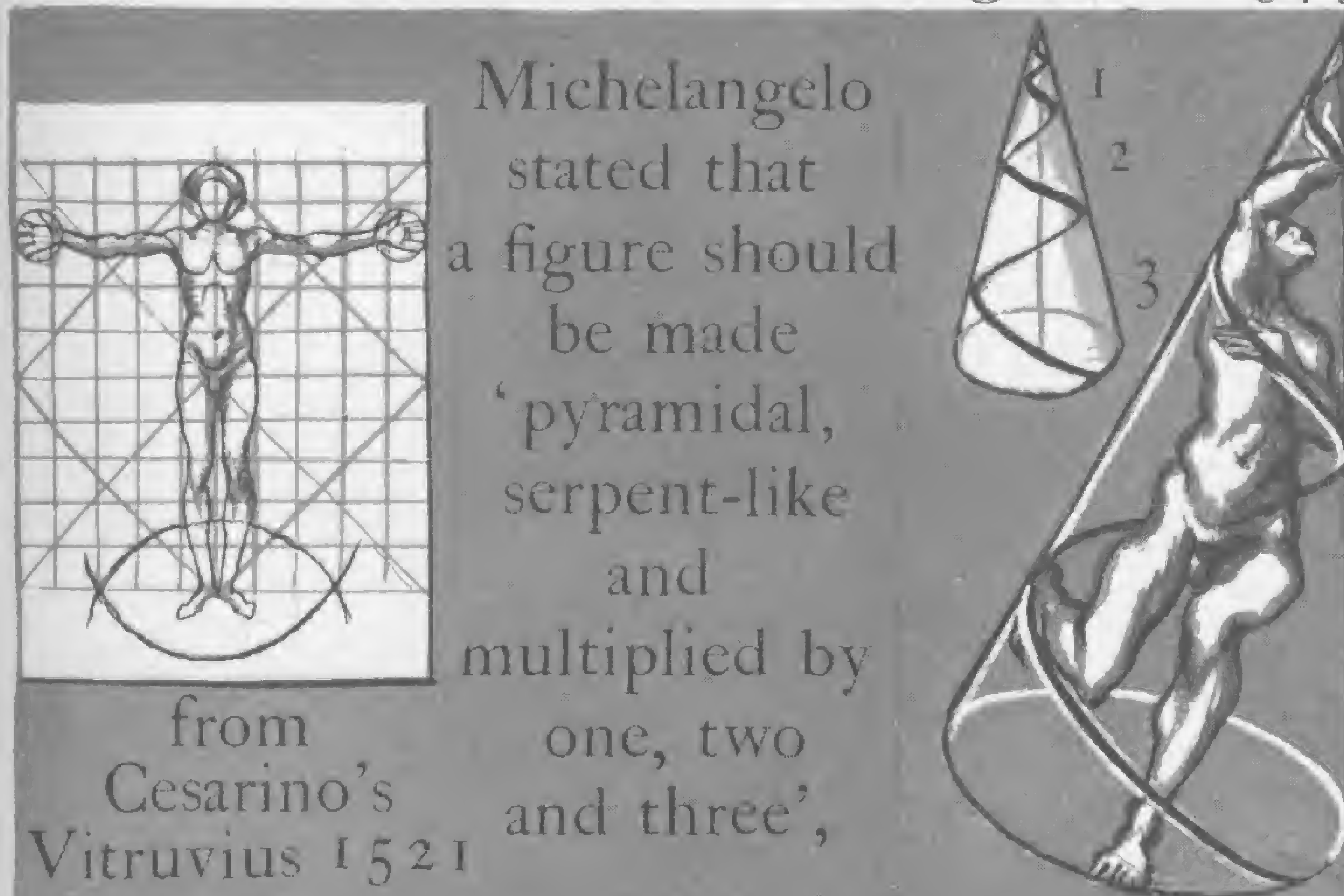
Vitruvius
First English
translation
1692



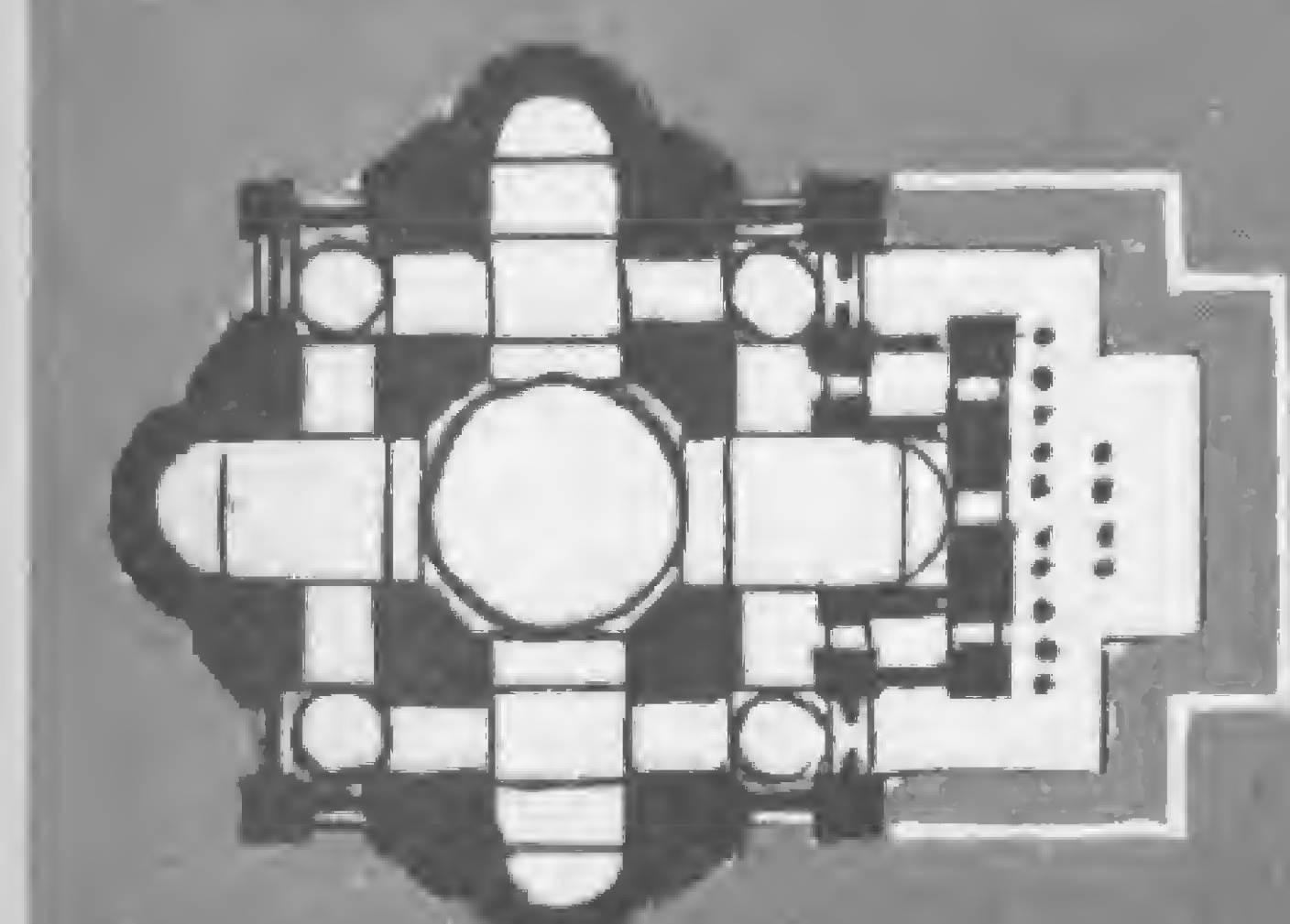
1475 — Sebastiano Serlio — 1554
Born Bologna. Architect, worked in France



1507 — Giacomo Barozzo Da Vignola — 1573



Michelangelo
stated that
a figure should
be made
'pyramidal,
serpent-like
and
multiplied by
one, two
and three',
from
Cesarino's
Vitruvius 1521



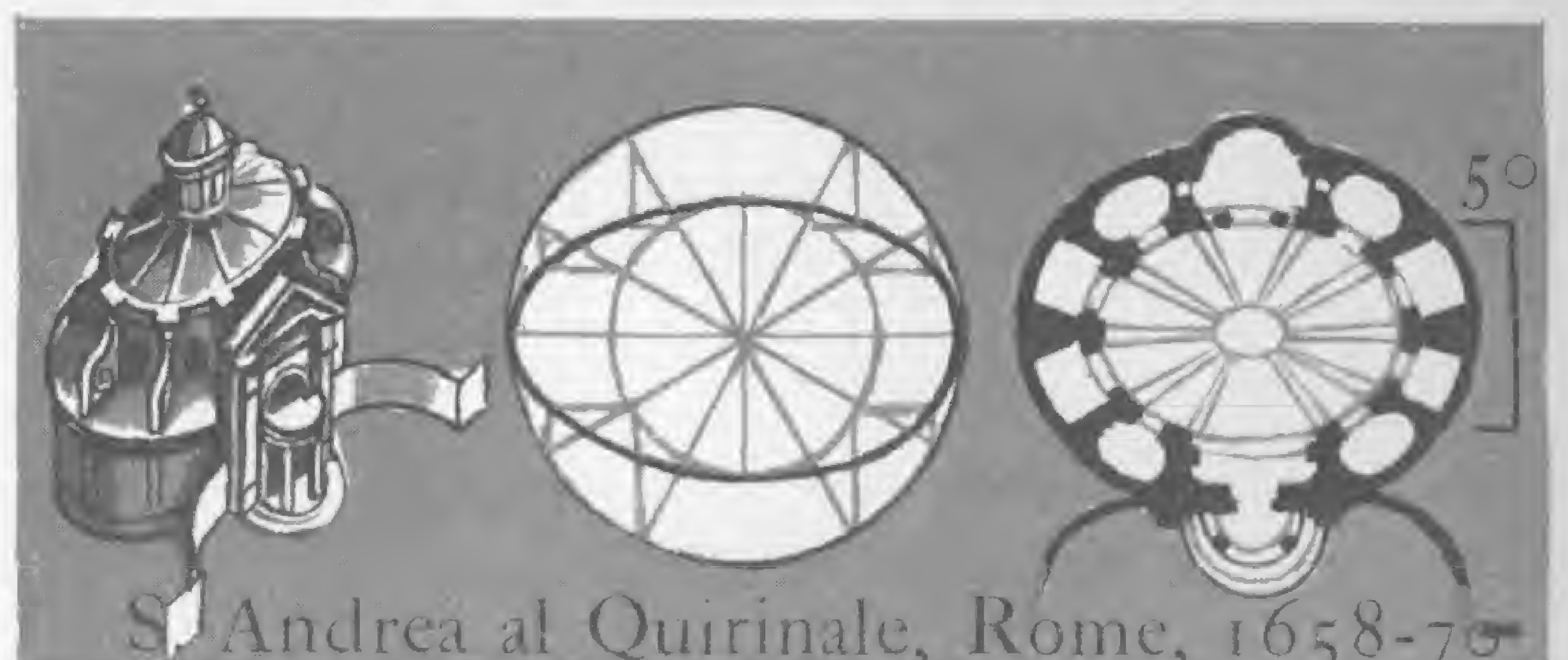
St Peter's, Rome, 1506

and wrote in a letter:
'... the architectural
members derive from
human members'.

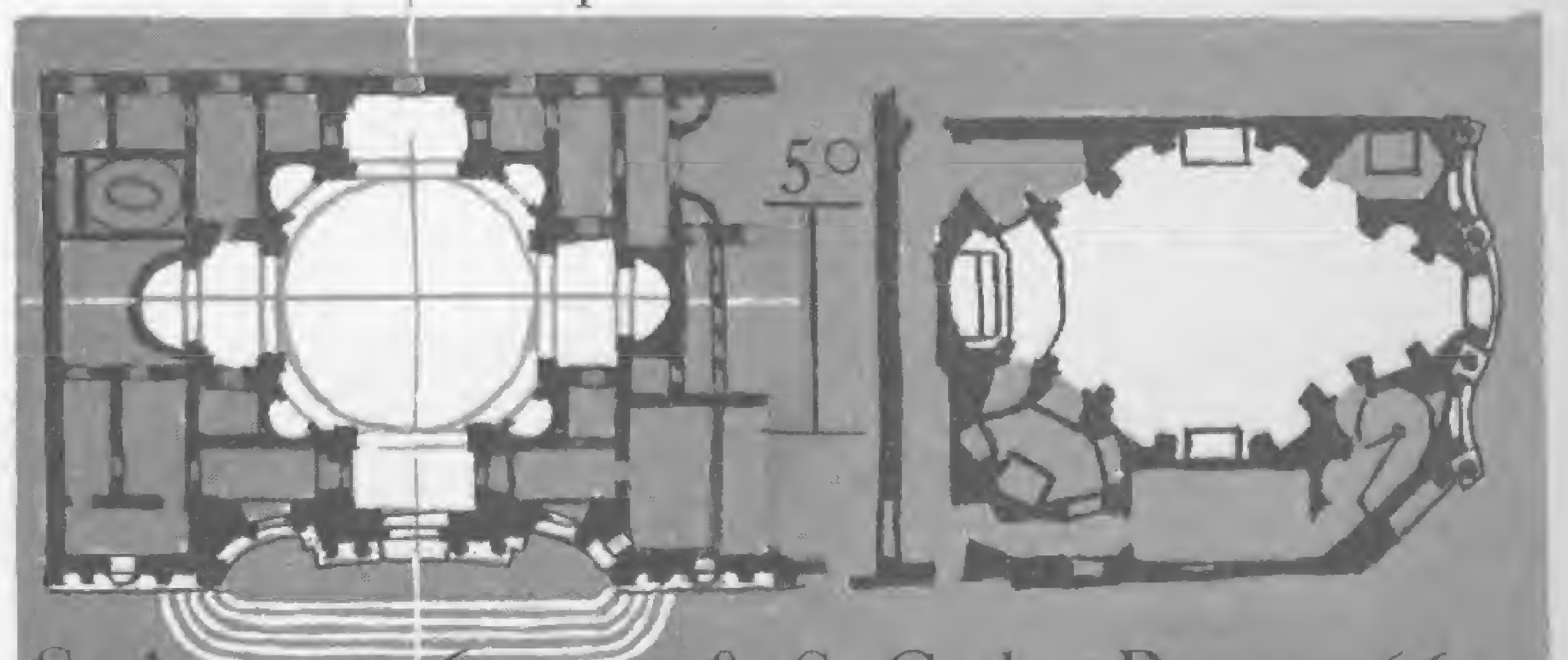
1475 — Michelangelo — 1564

1508 — Andrea Palladio (pp. 128-9) — 1580

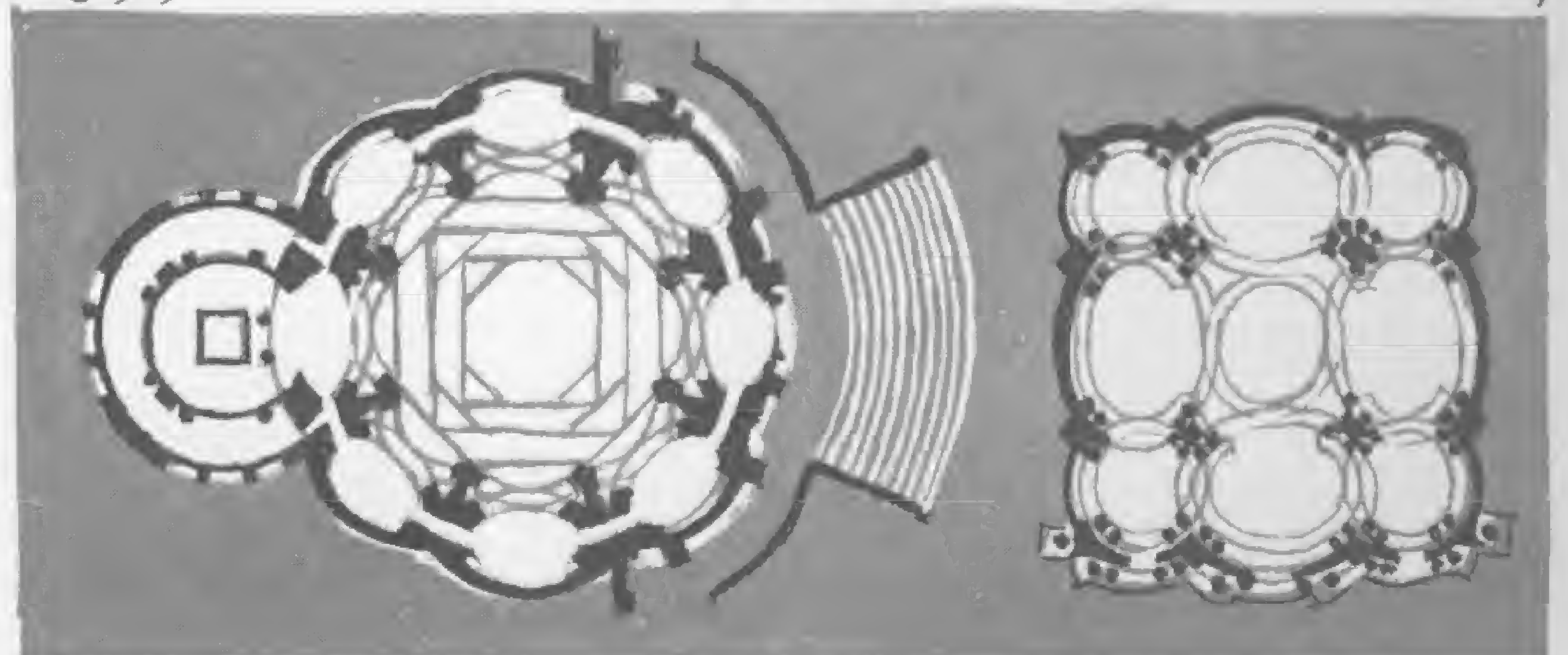
In Baroque churches musical ratios
were resolved into an orchestration of visual
forces comparable to the fugue, & measured
by the eye and the mind of the beholder



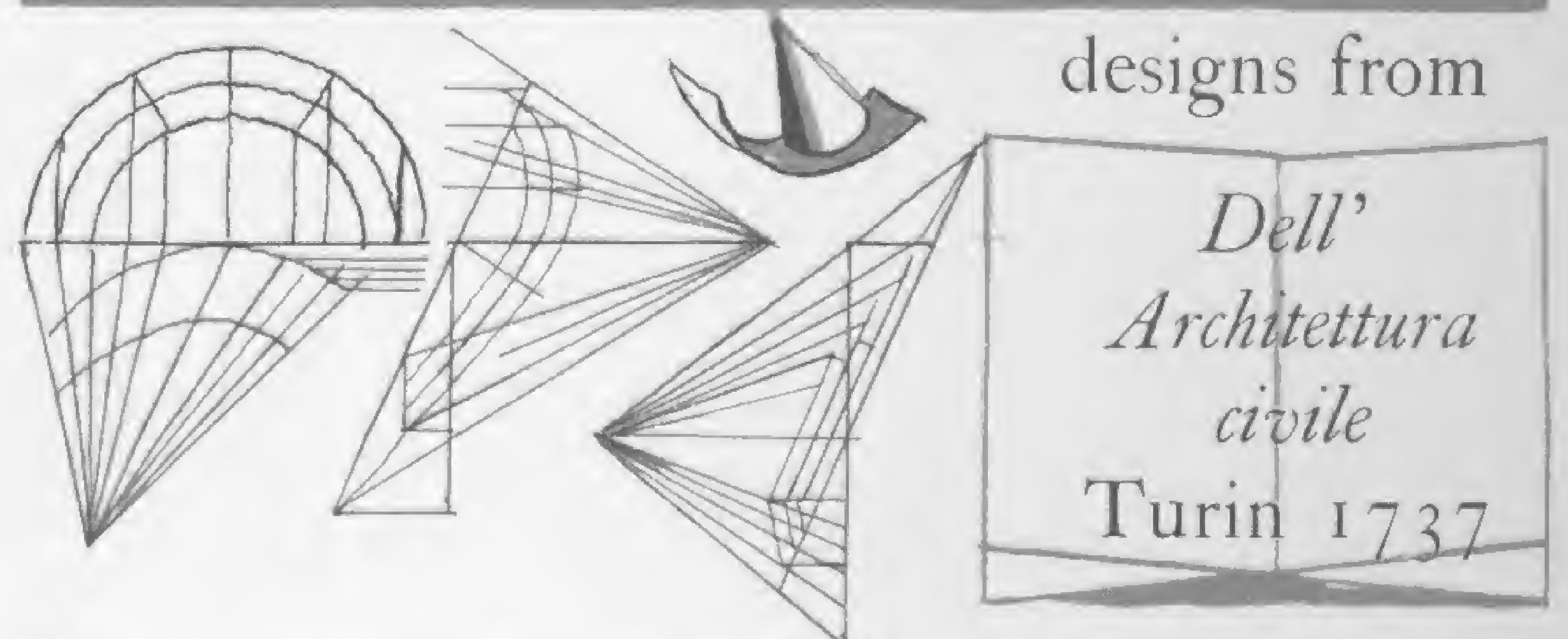
S. Andrea al Quirinale, Rome, 1658-70
1598 — Giovanni Lorenzo Bernini — 1680
sculptor and architect



S. Agnese 1653-55 & S. Carlo, Rome 1665-7
1599 — Francesco Borromini — 1667



designs from

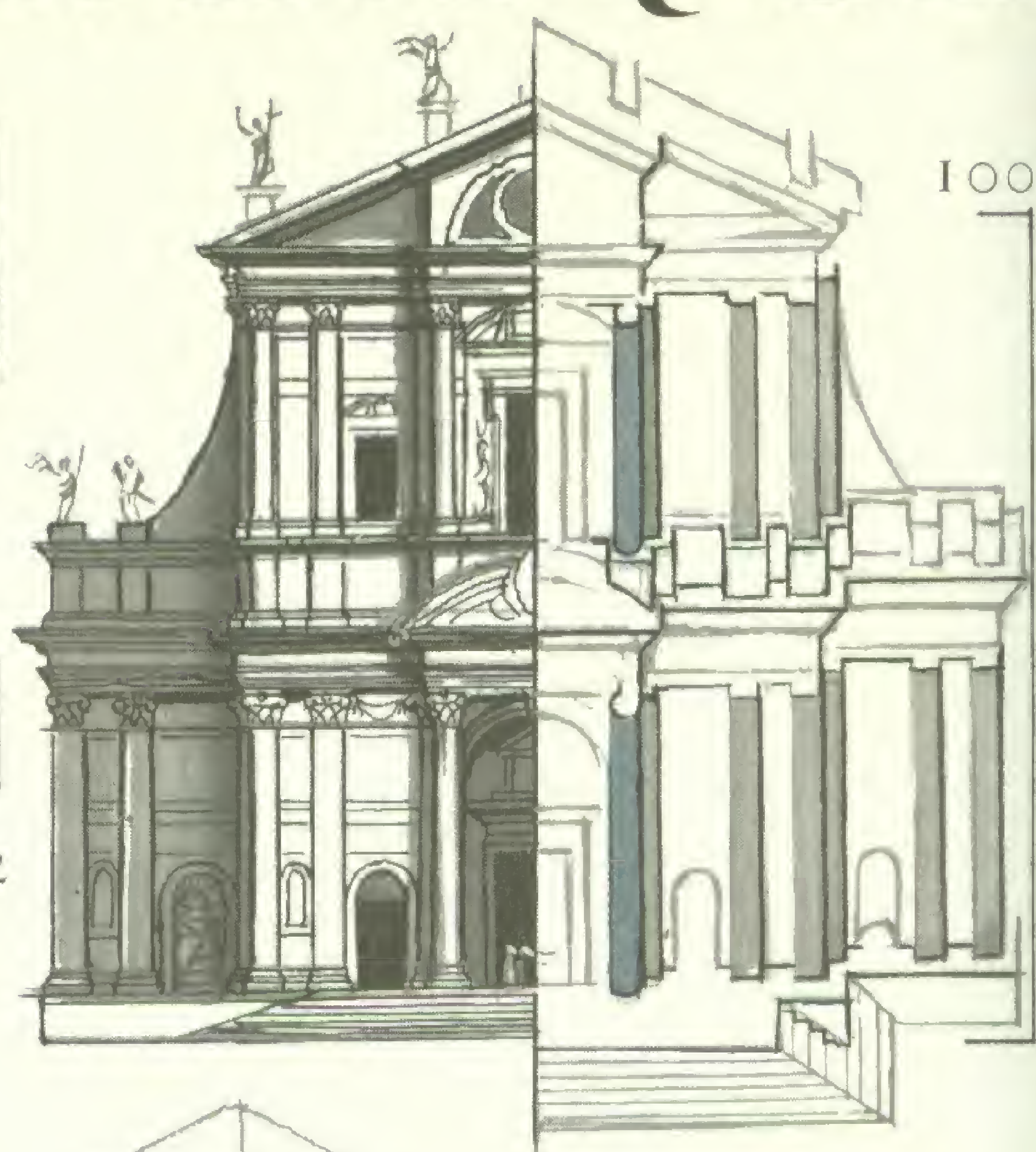


1624 — Guarino Guarini — 1683
mathematician & architect, mostly at Turin

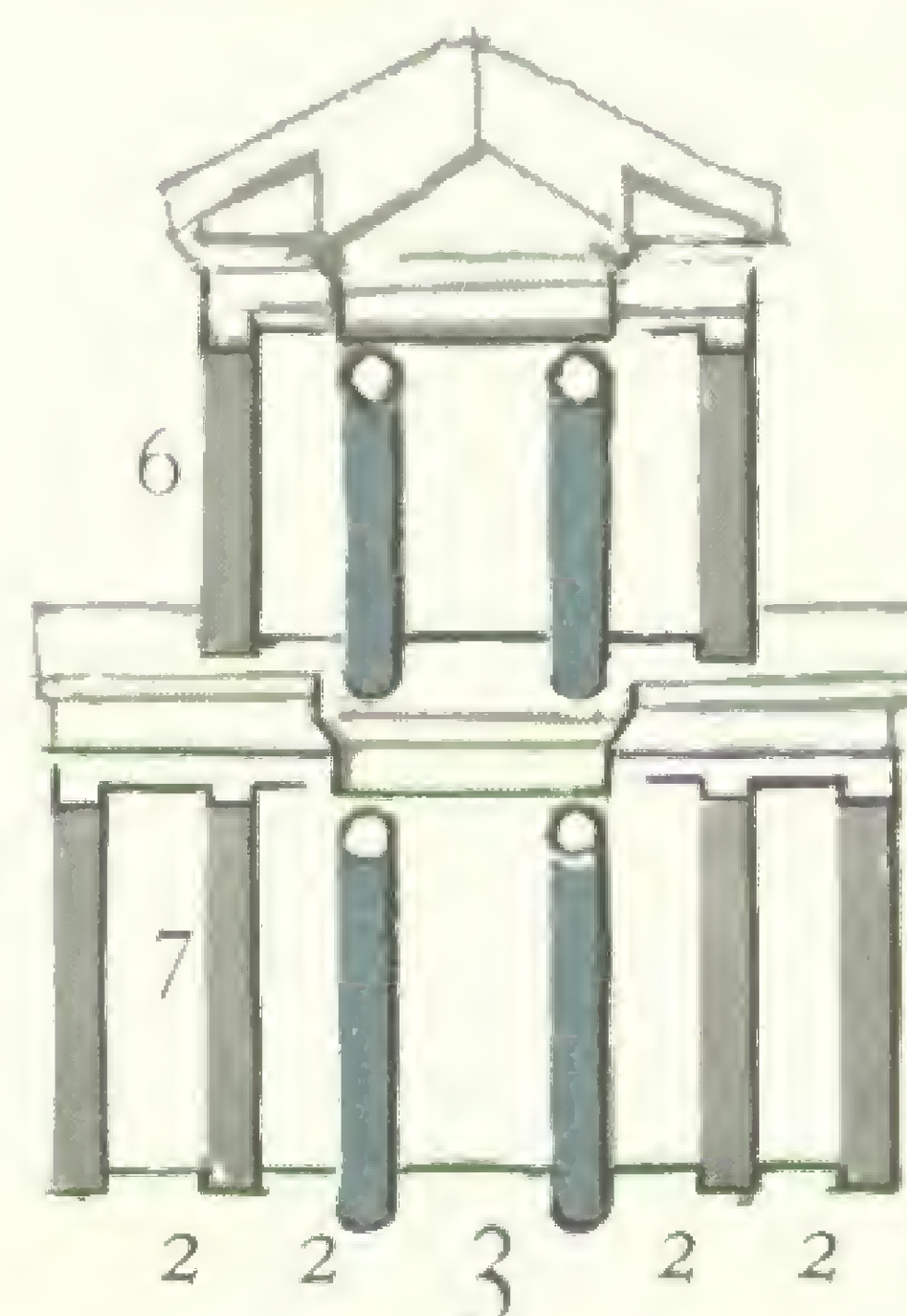
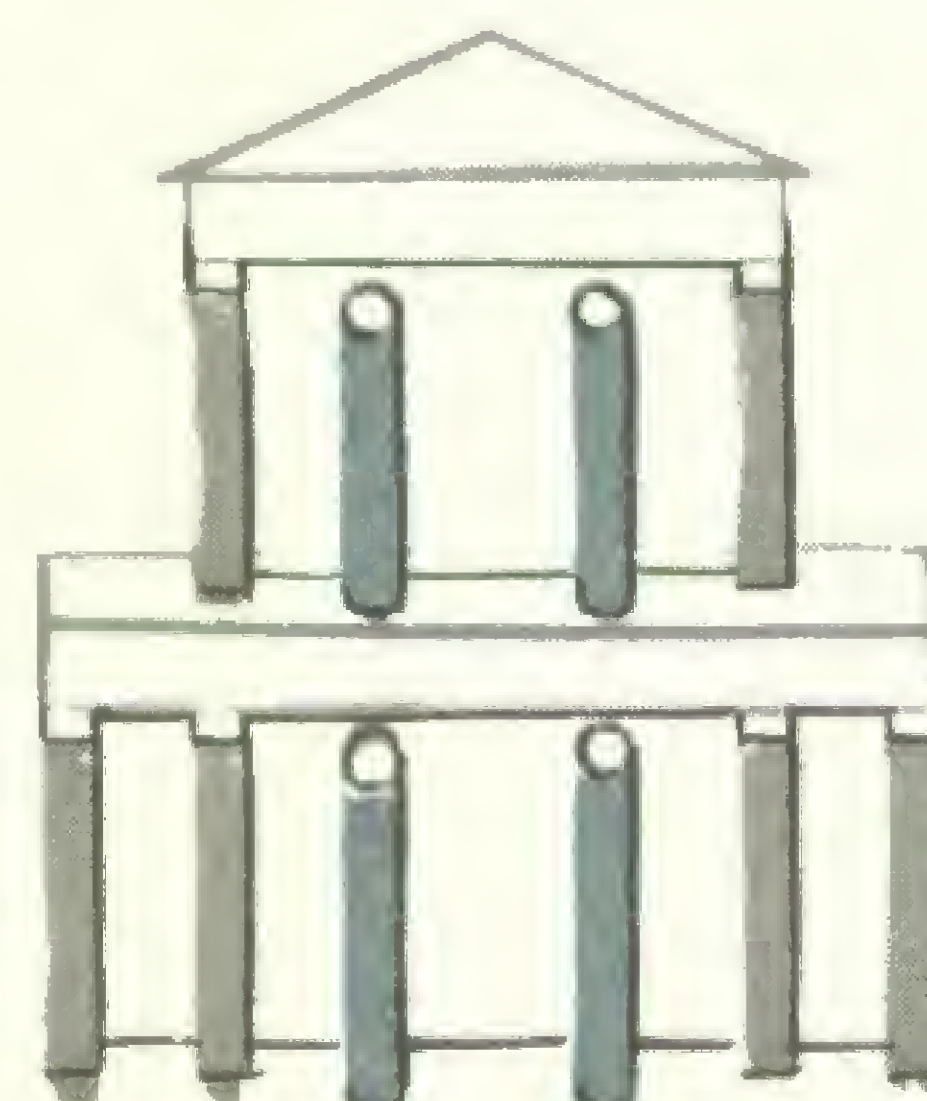
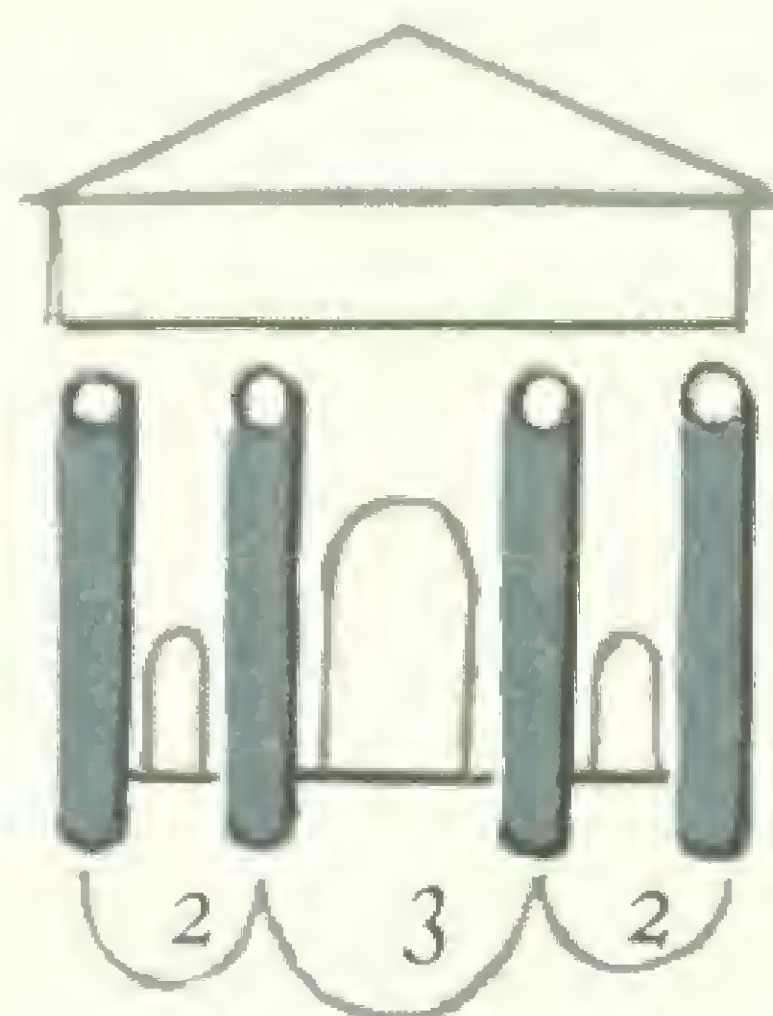
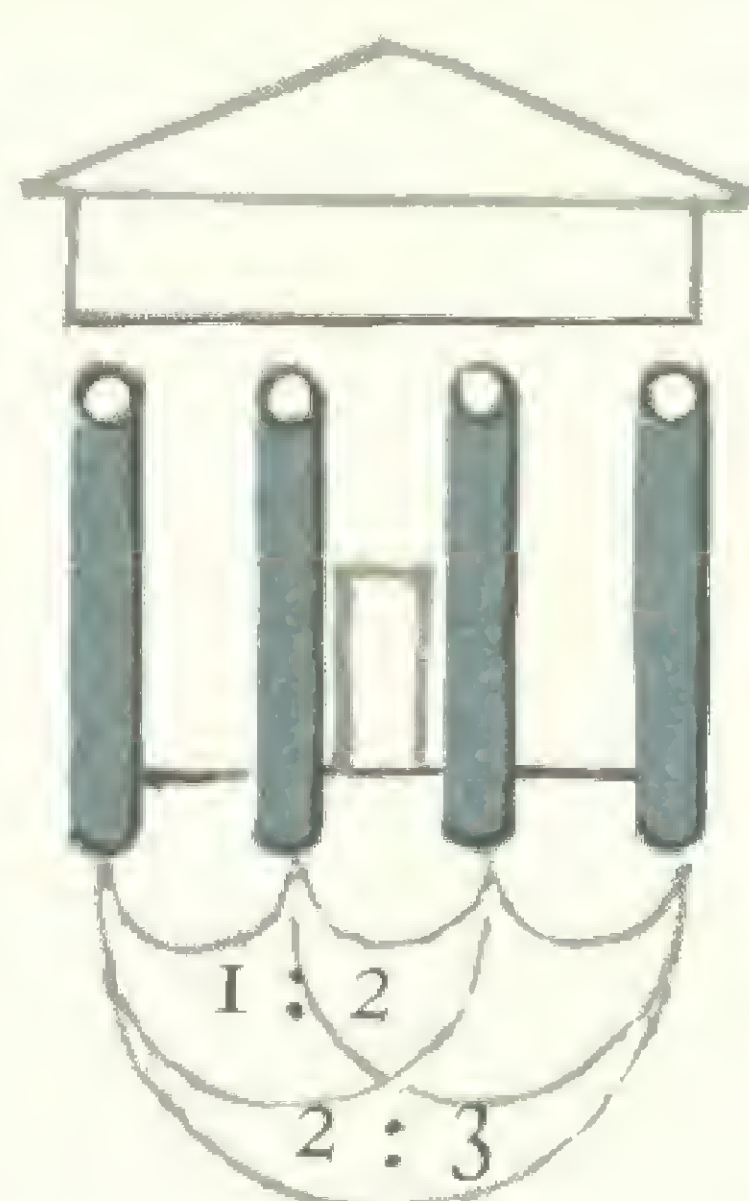
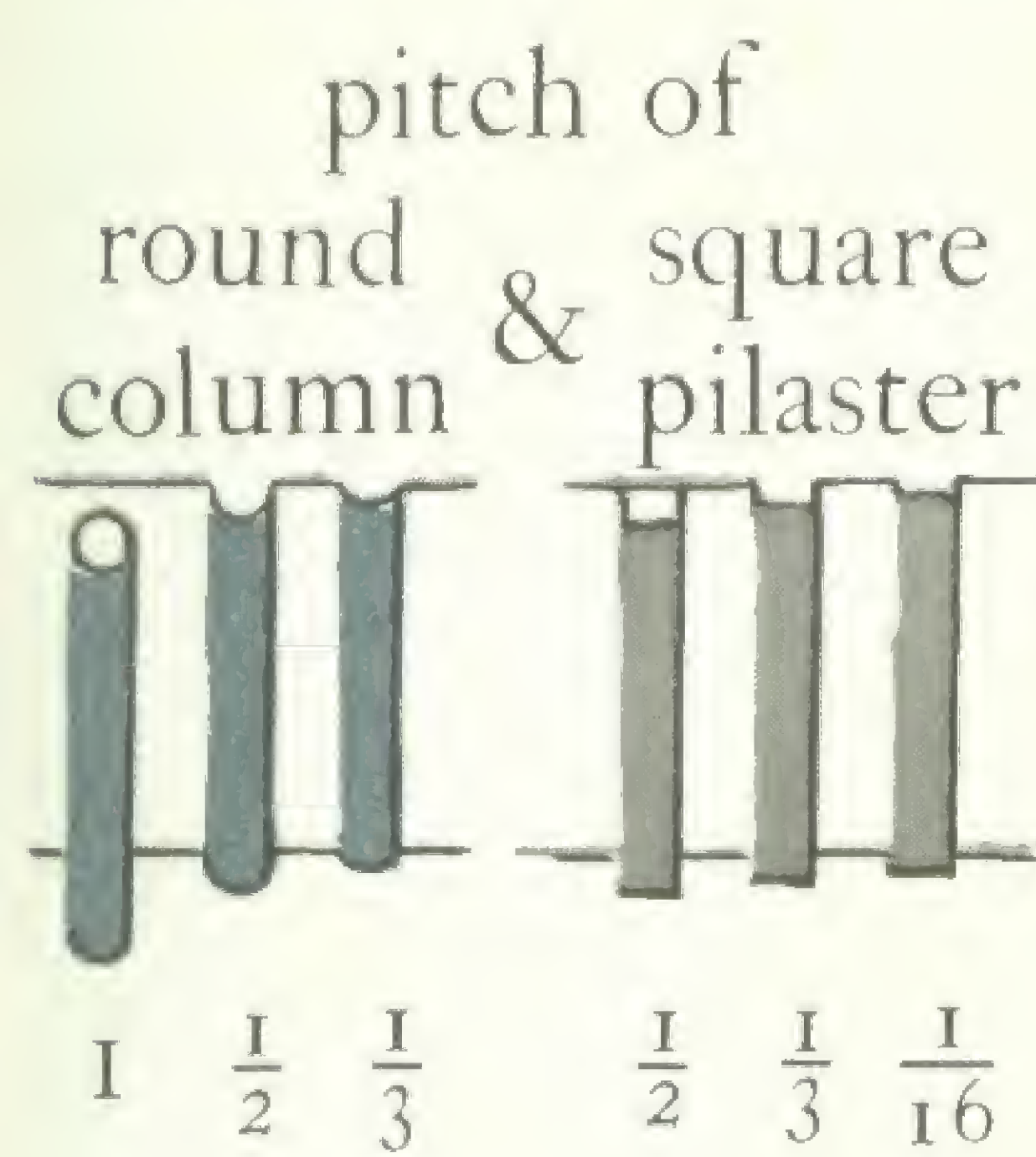
RENAISSANCE - BAROQUE



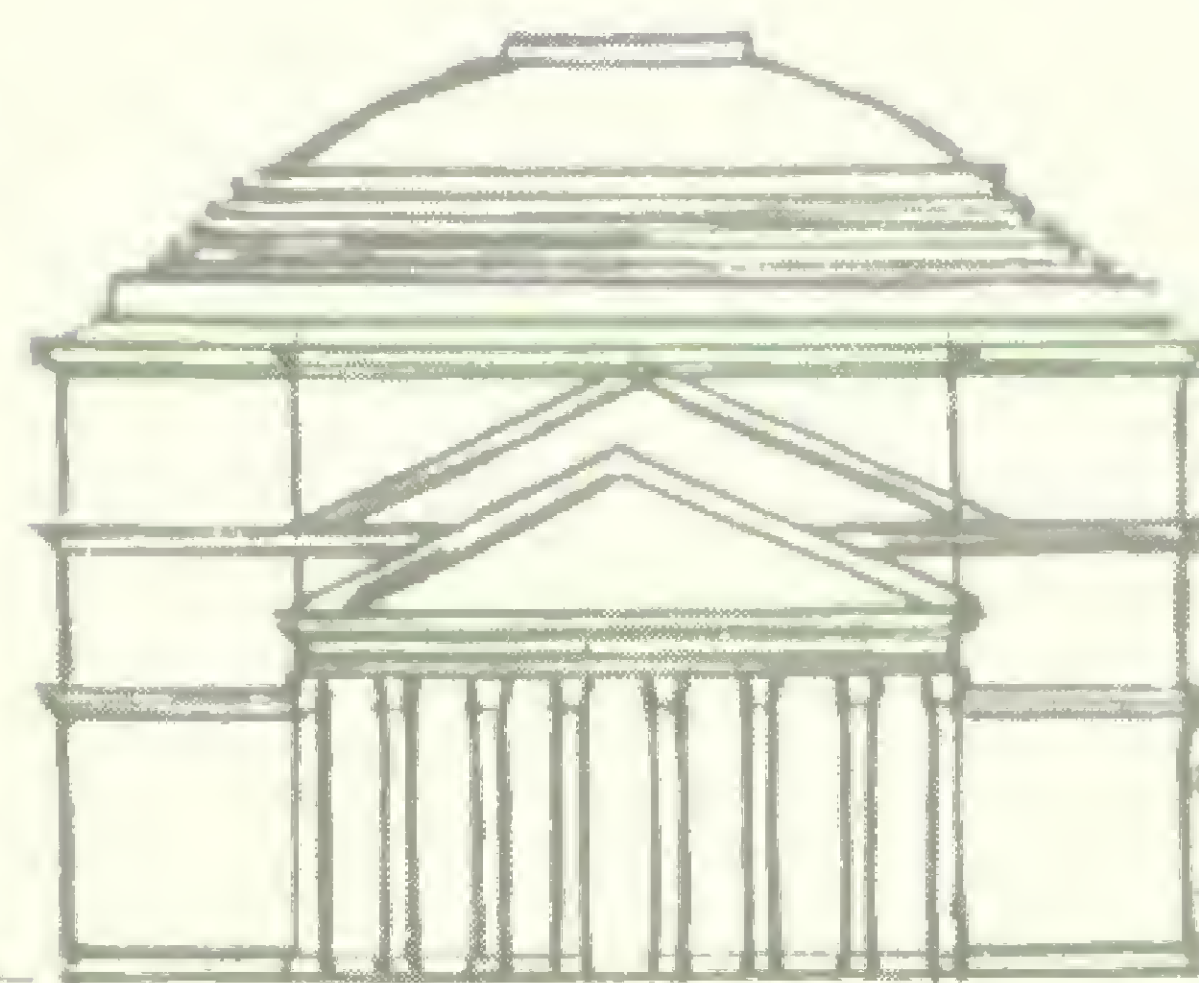
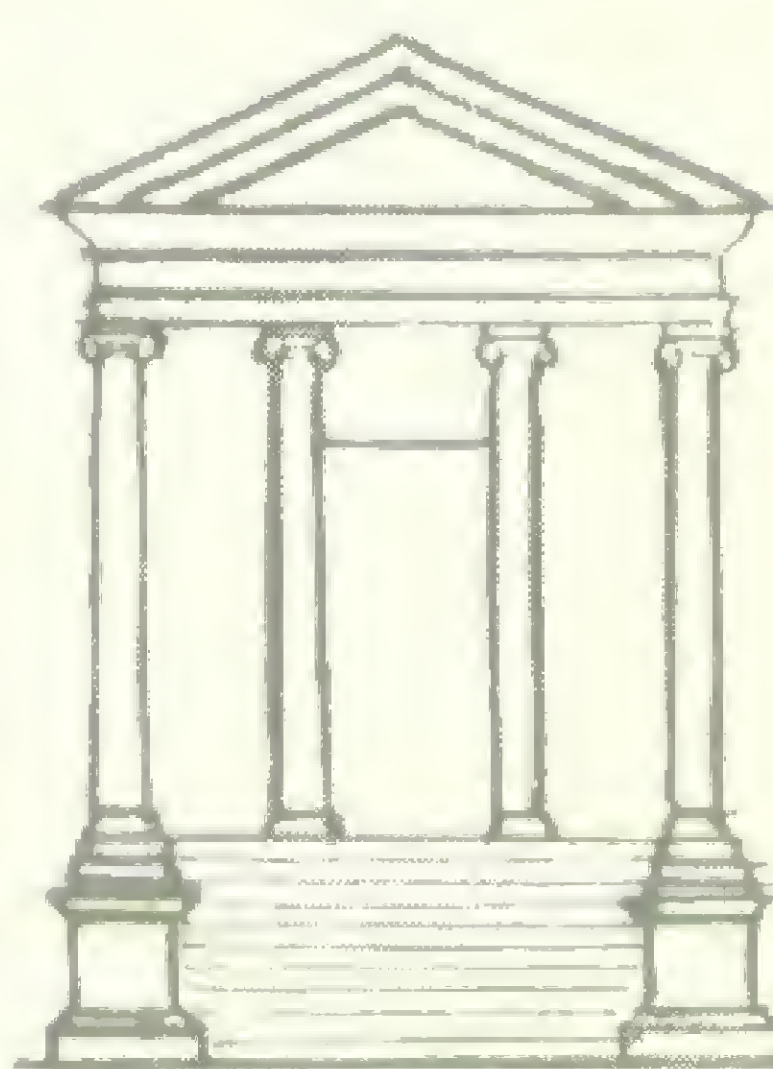
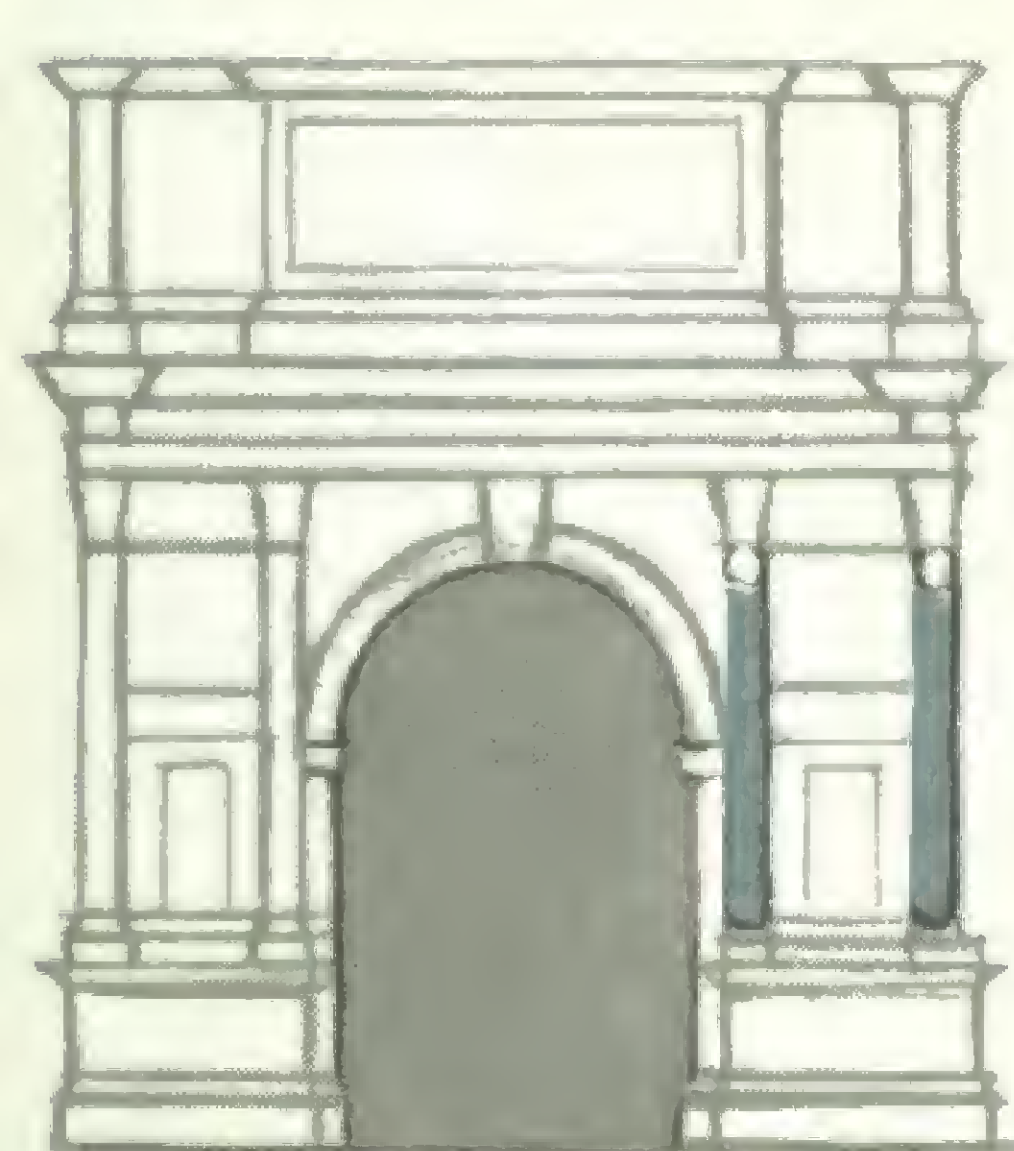
Baptistery, S. Miniato, S. Maria Novella, Florence, c. 1456
Alberti (1404-72)



The Gesù,
Rome, 1568-75
Vignola
(1507-73)
(p. 122)

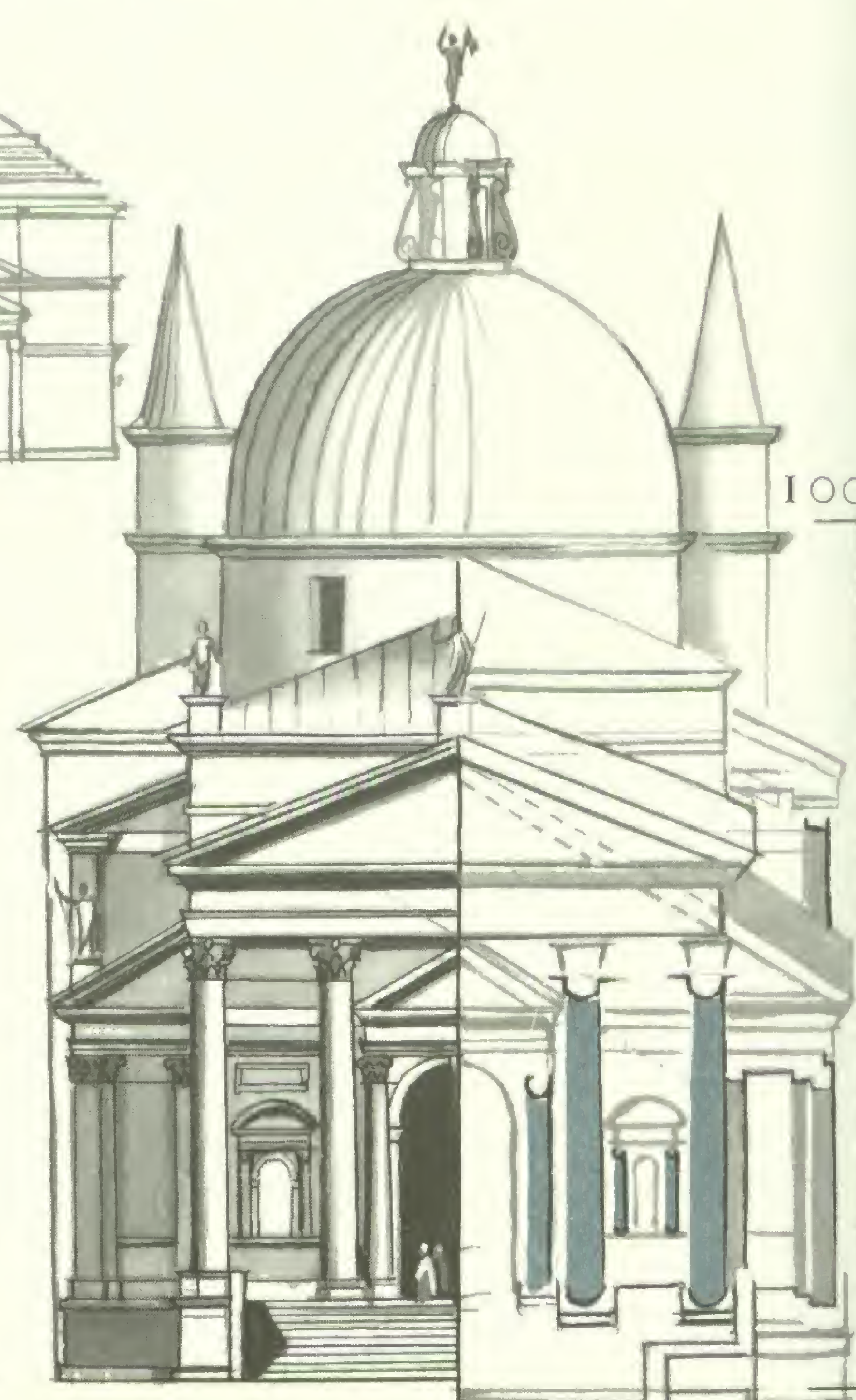
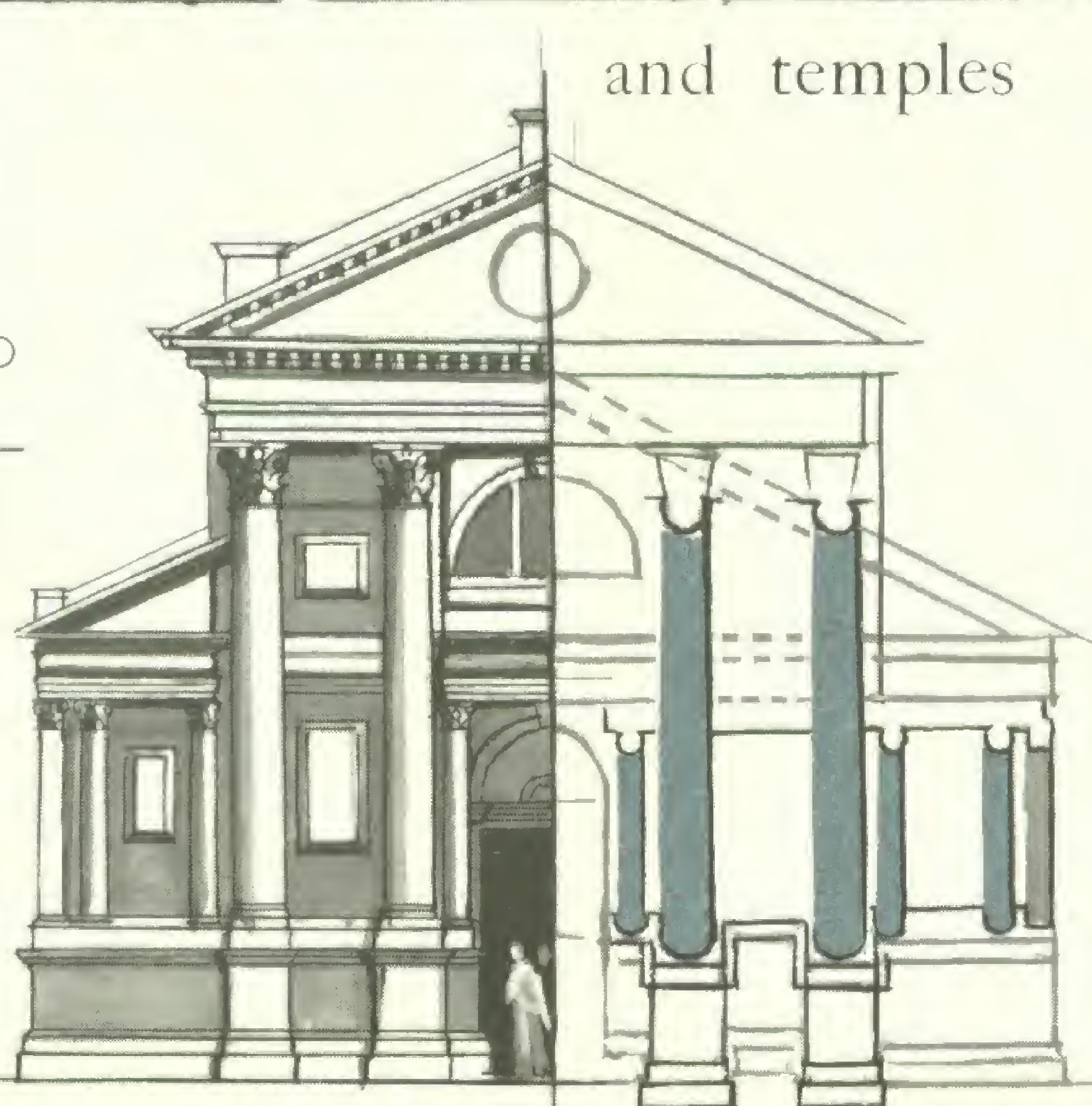
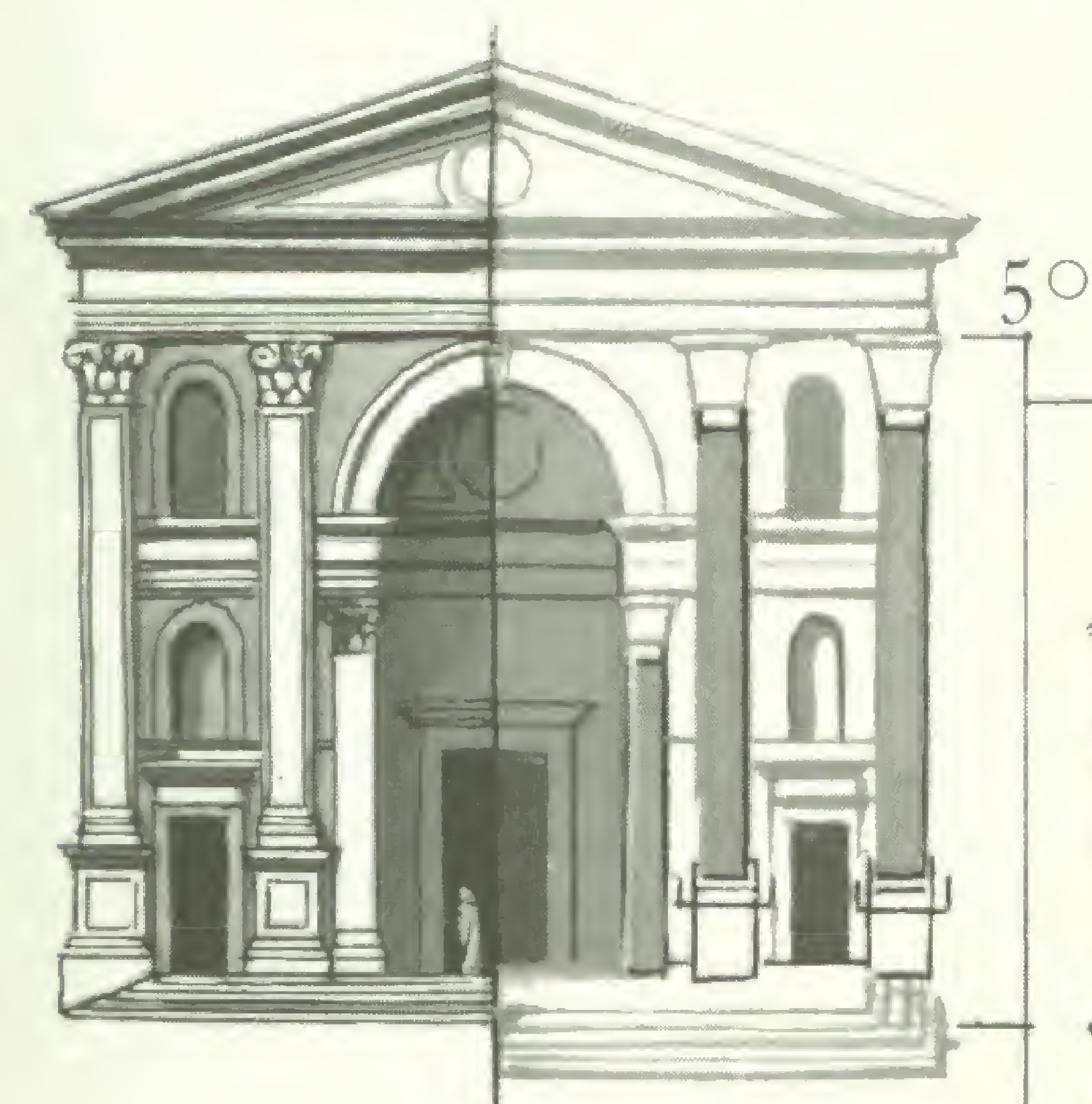


Arrangement & permutations of columns & pilasters to compose a visual 'overture'



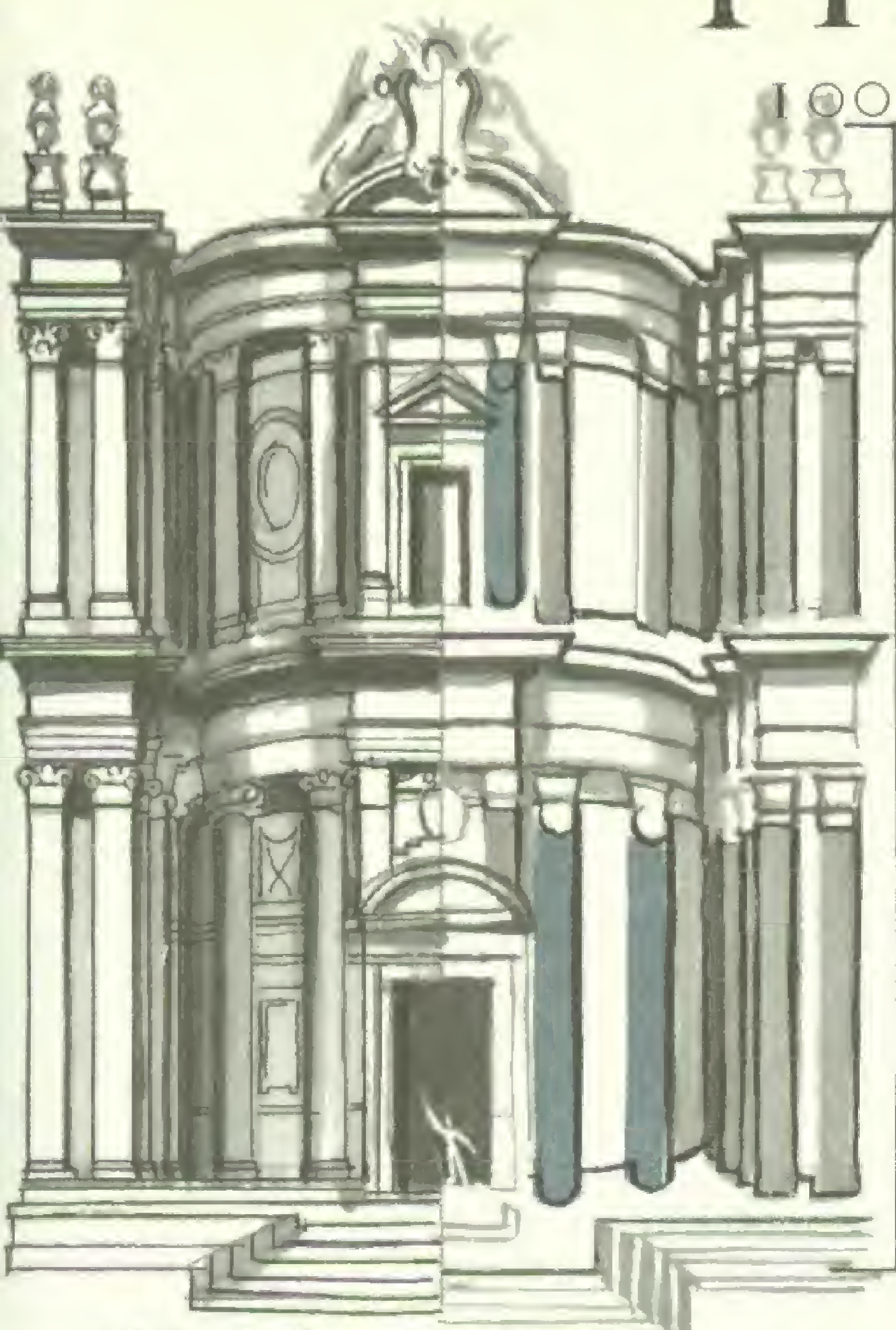
Roman arches

and temples

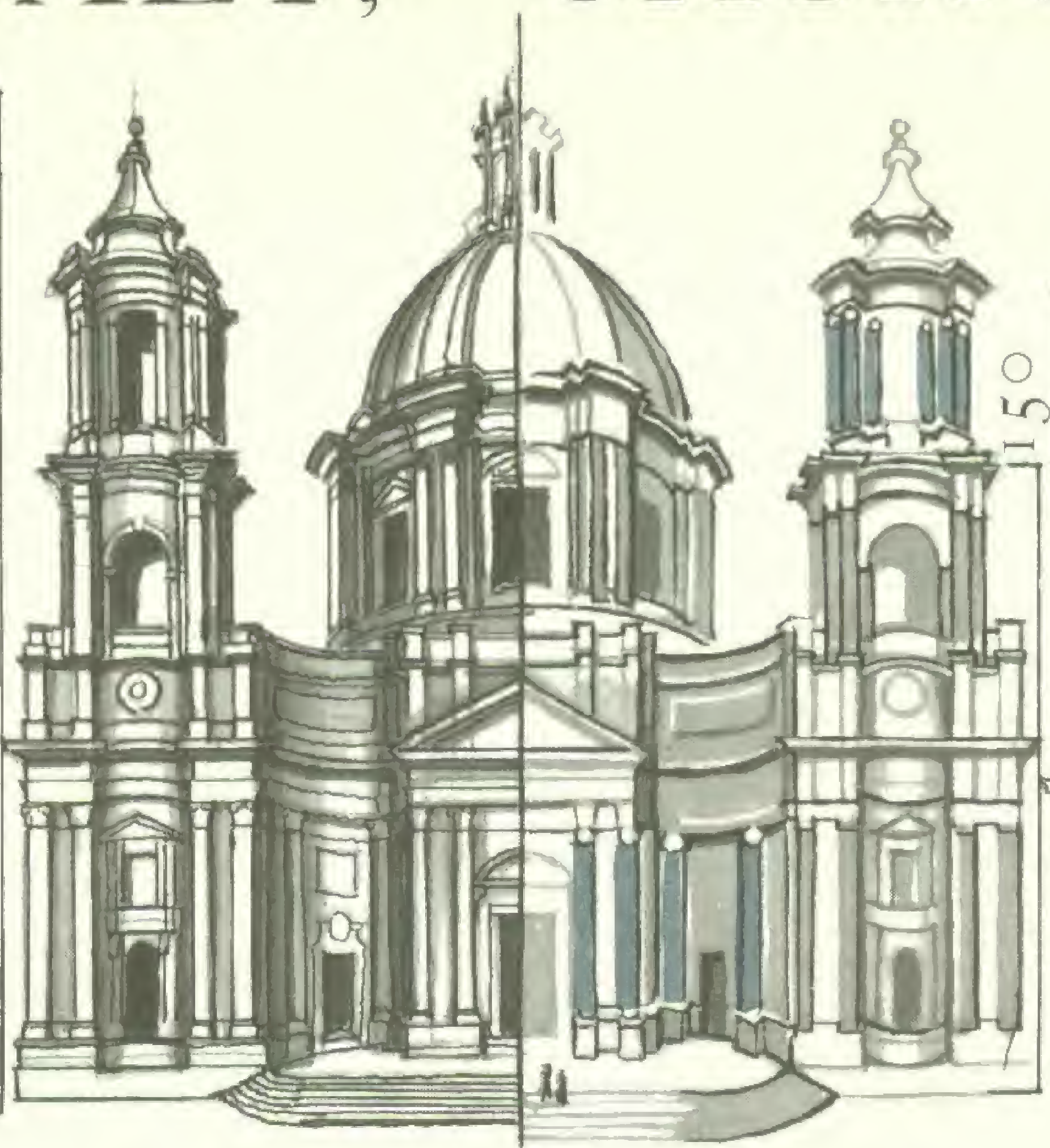


S. Andrea, Mantua, 1470 *Alberti (p. 122)* S. Francesco della Vigna, Venice, 1562 *Andrea Palladio (1508-1580)* Il Redentore, Venice, 1576-92

ITALY, CHURCH FACADES



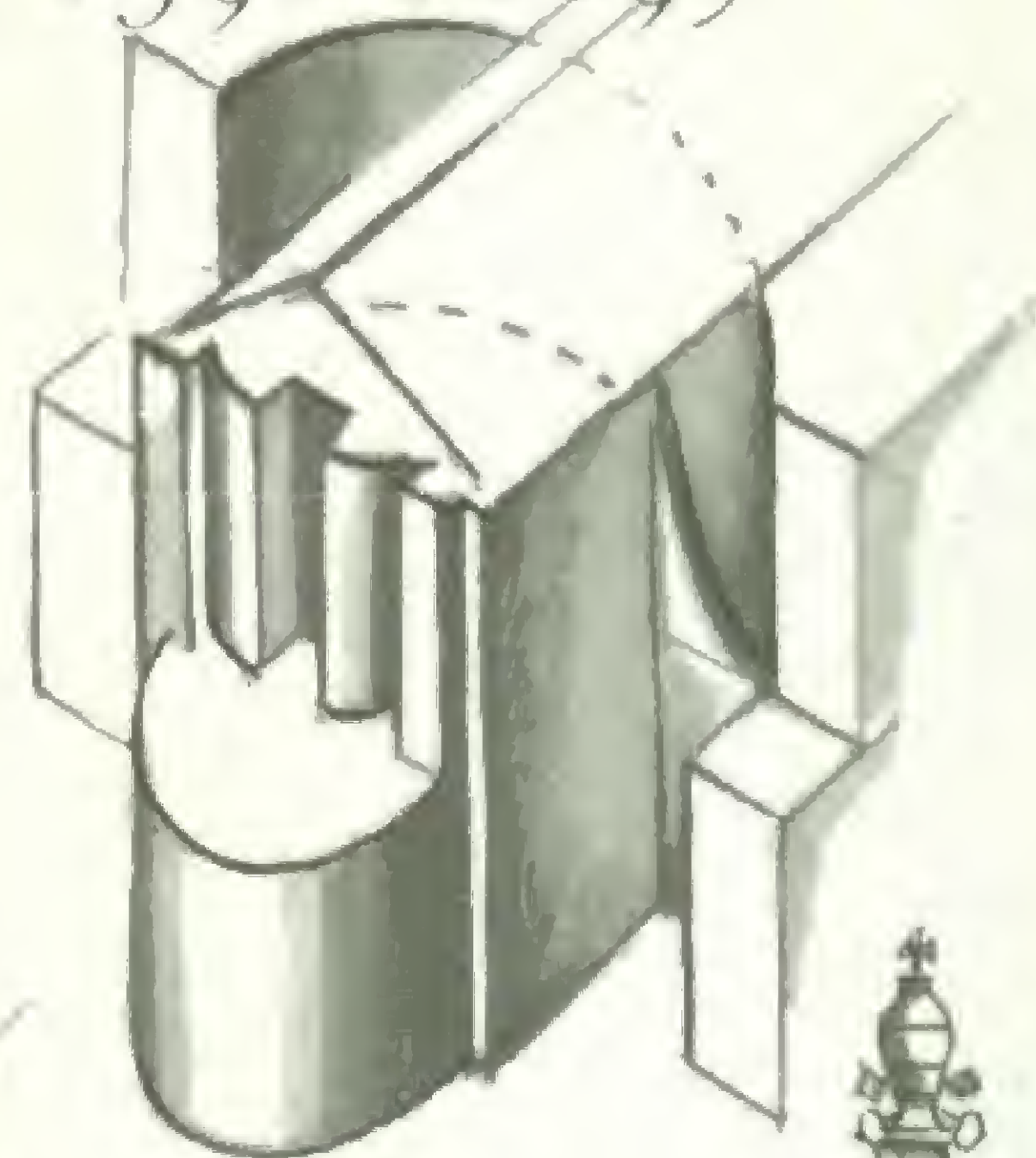
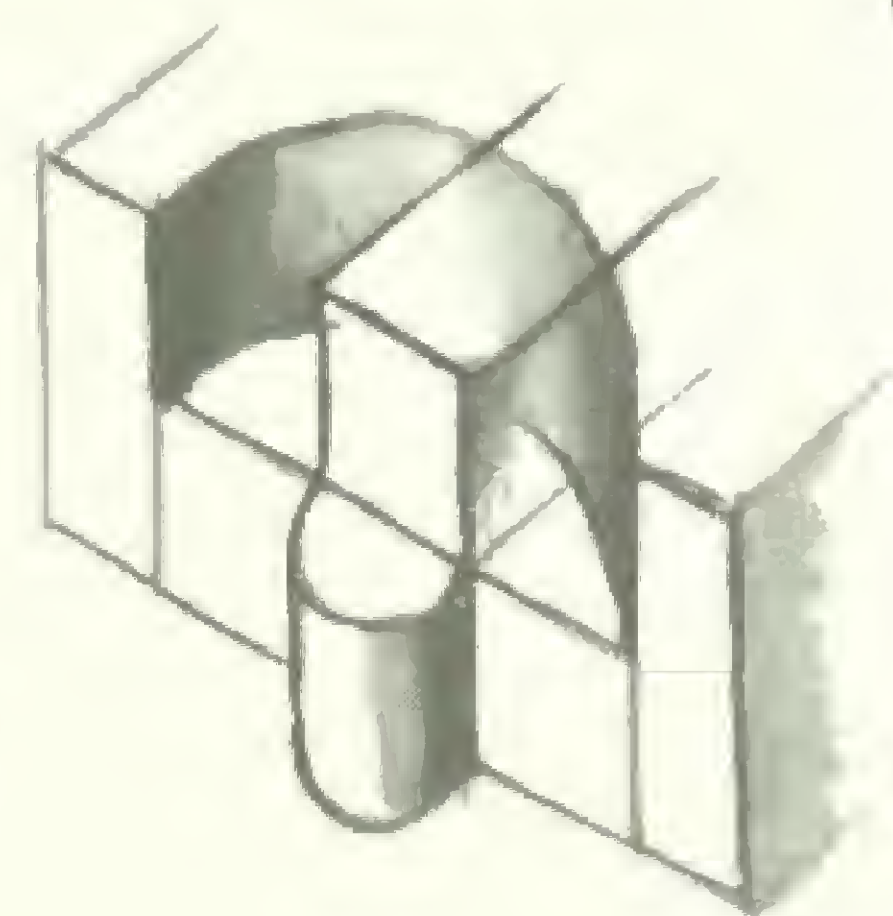
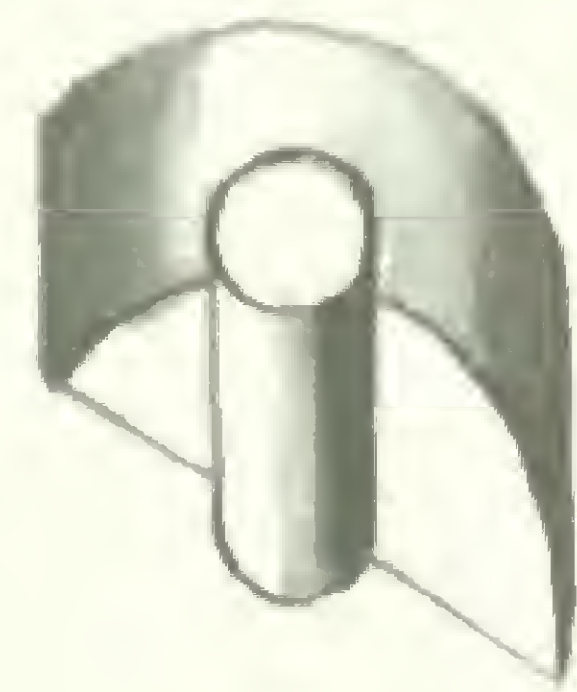
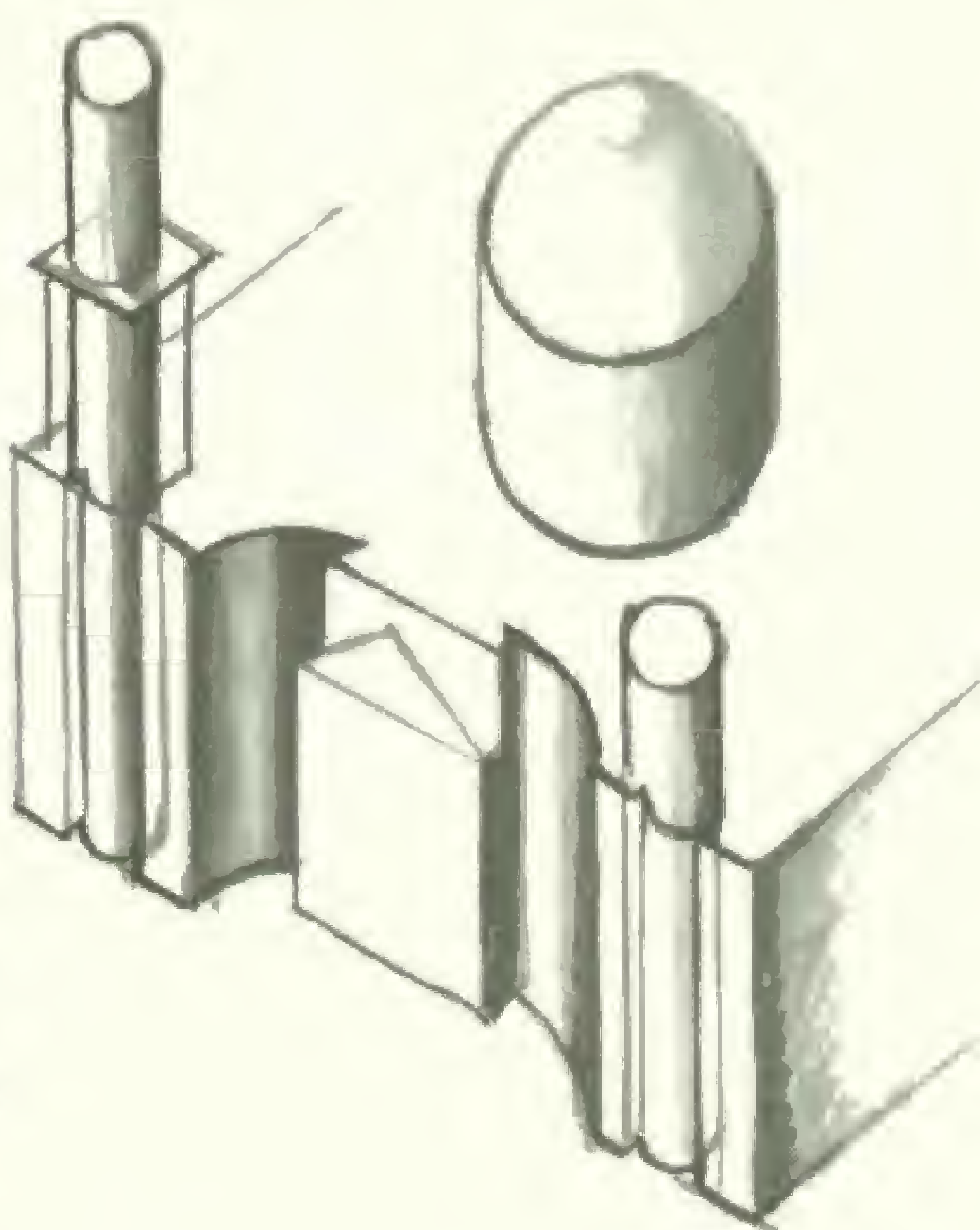
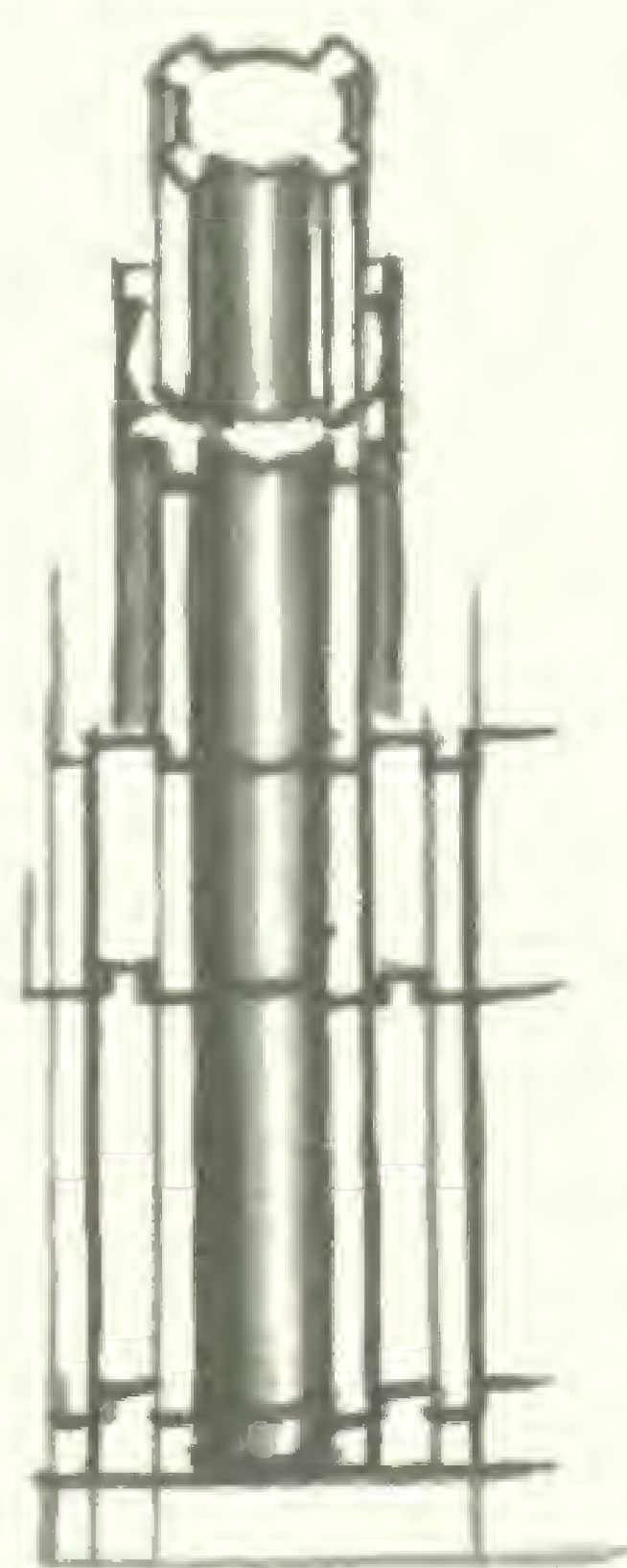
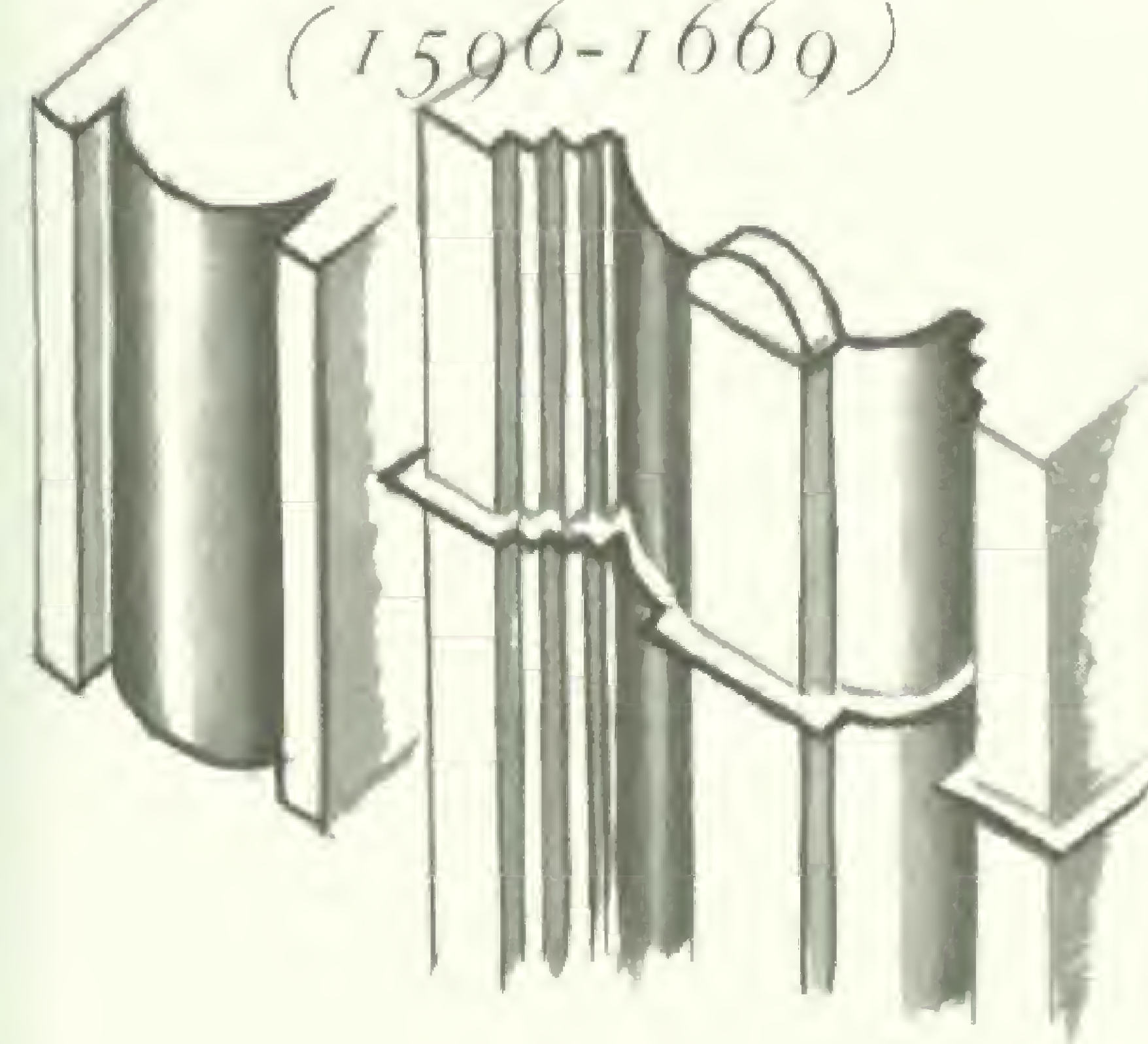
SS. Martina e Luca,
Rome, 1635-50
Pietro da Cortona
(1596-1669)



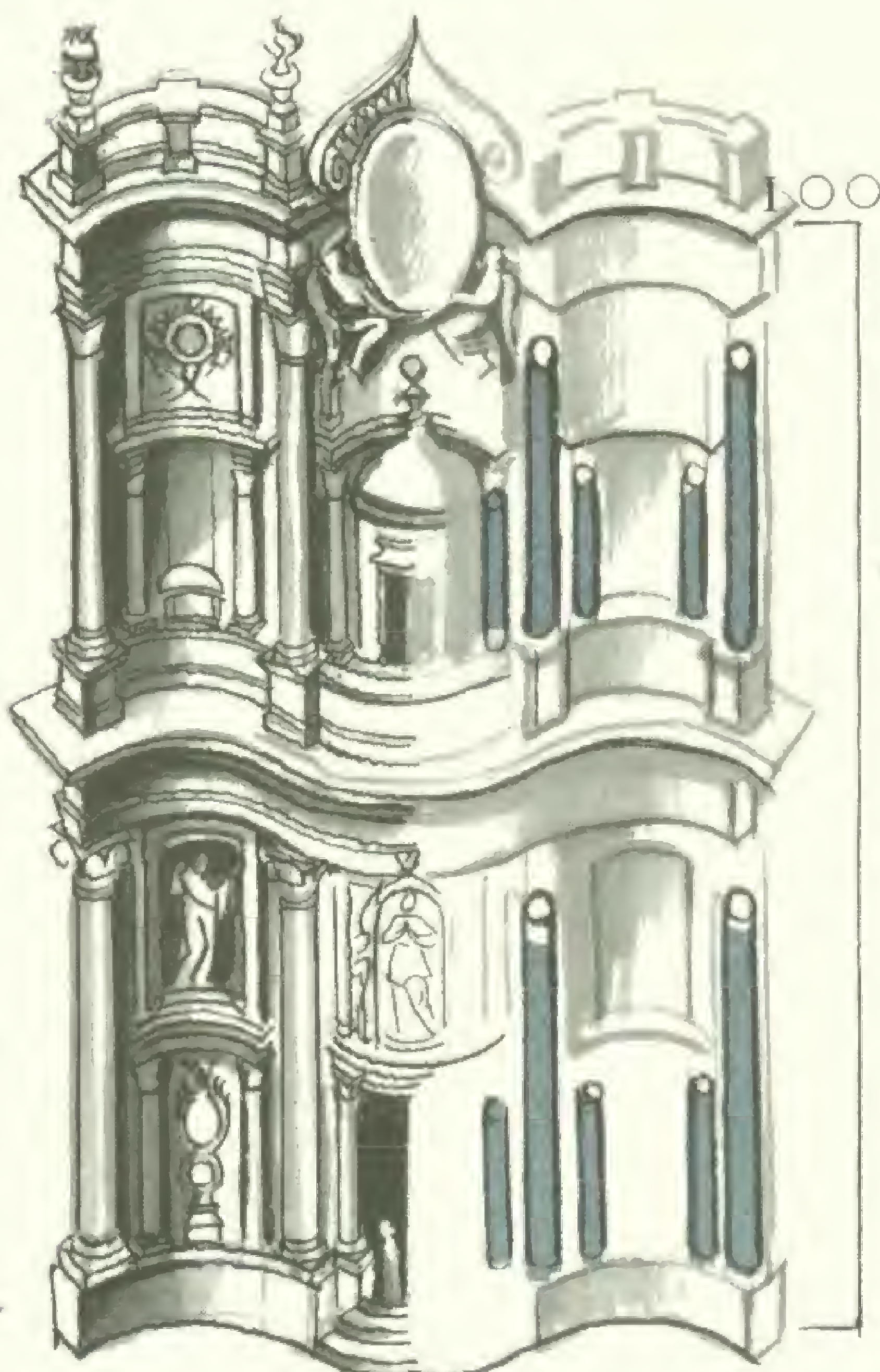
S. Agnese in Piazza Navona,
Rome, 1653-55
Francesco Borromini (1599-1667)



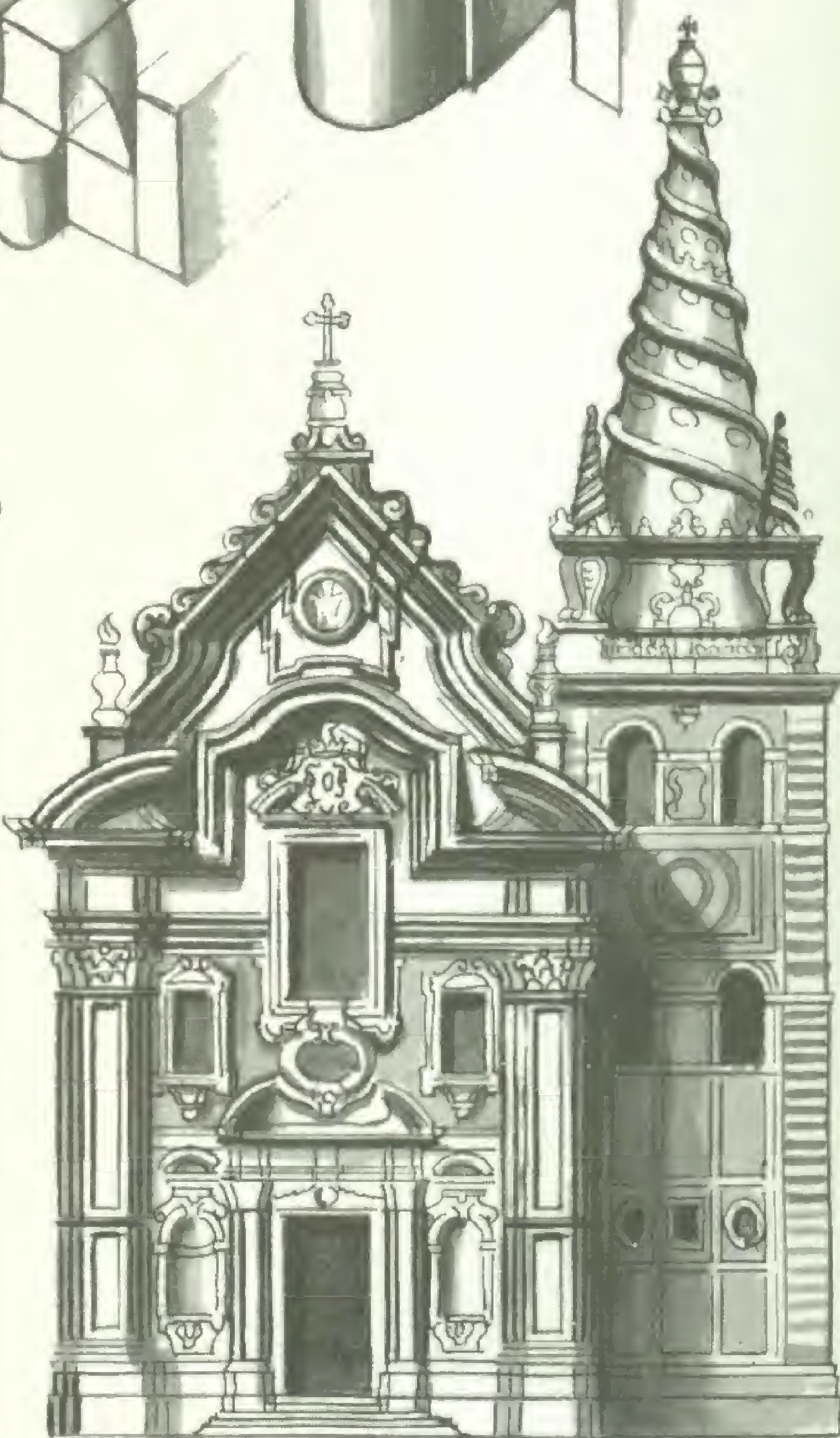
S. Maria della Pace,
Rome, 1656-57
Pietro da Cortona
(1596-1669)



S. Susanna, Rome, 1597-1603
Carlo Maderna (1556-1629)

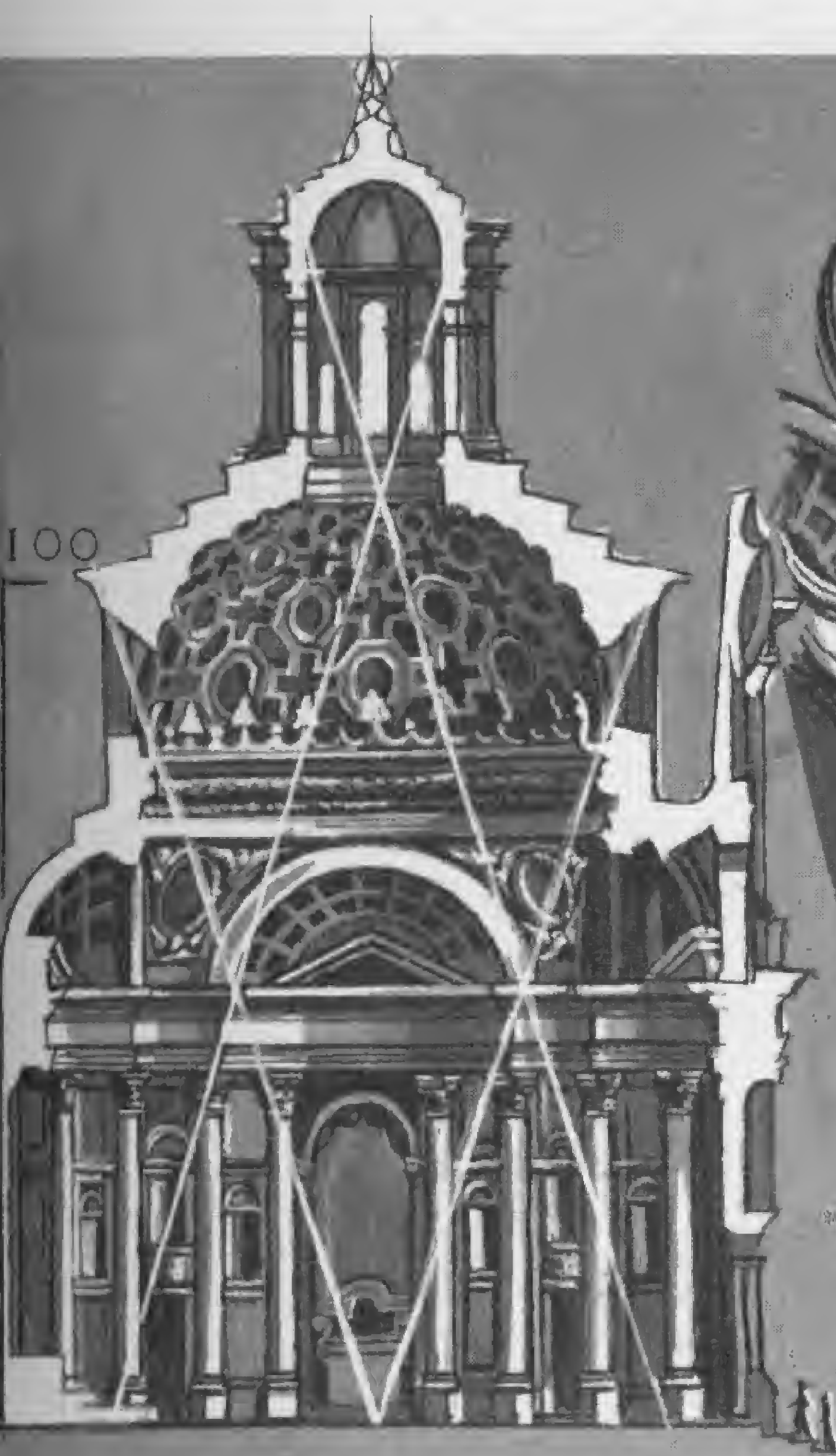


S. Carlo, Rome, 1665-7
Borromini (p. 123)

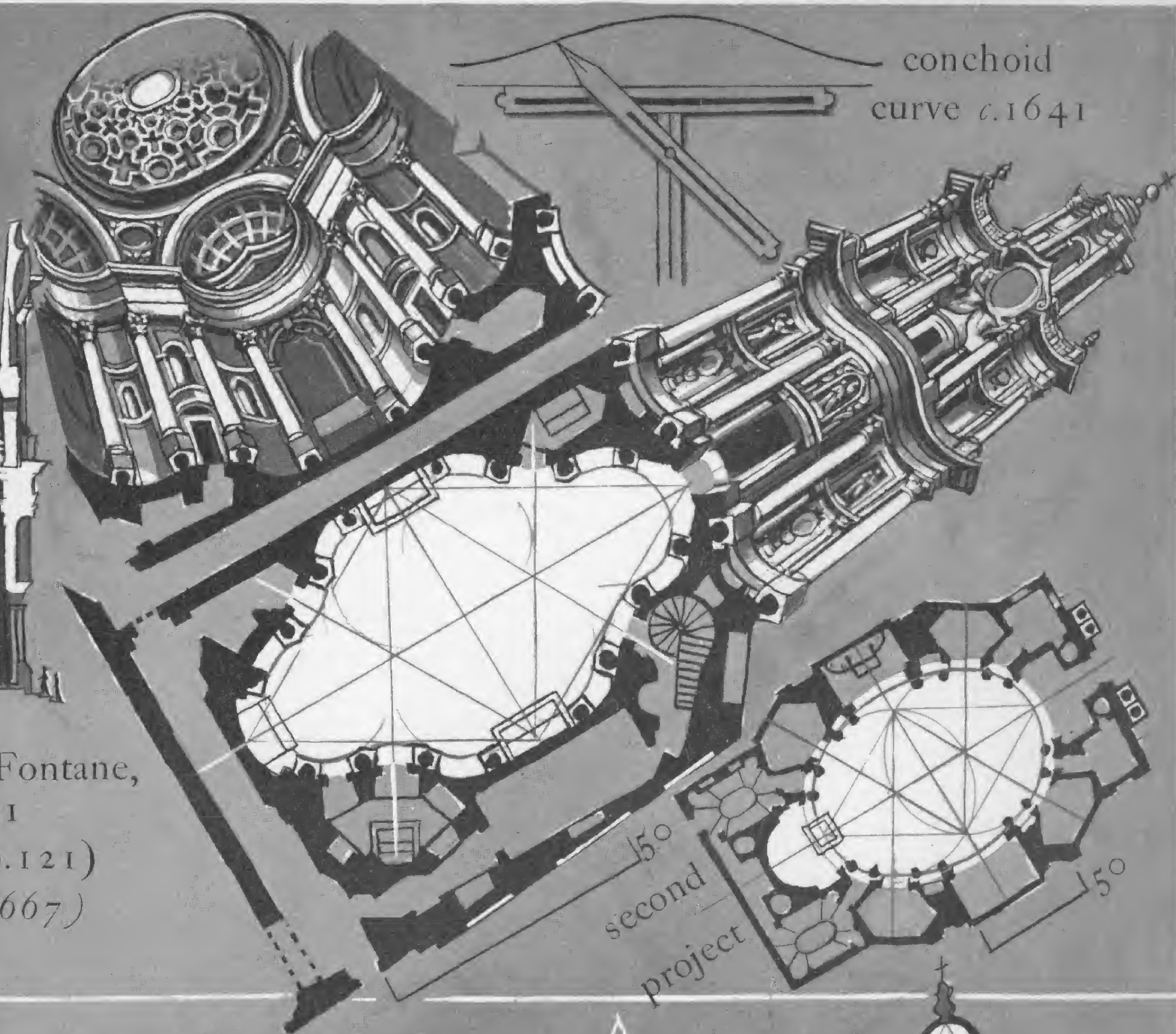


S. Gregorio, Messina, 1660
Guarini (1624-1683)

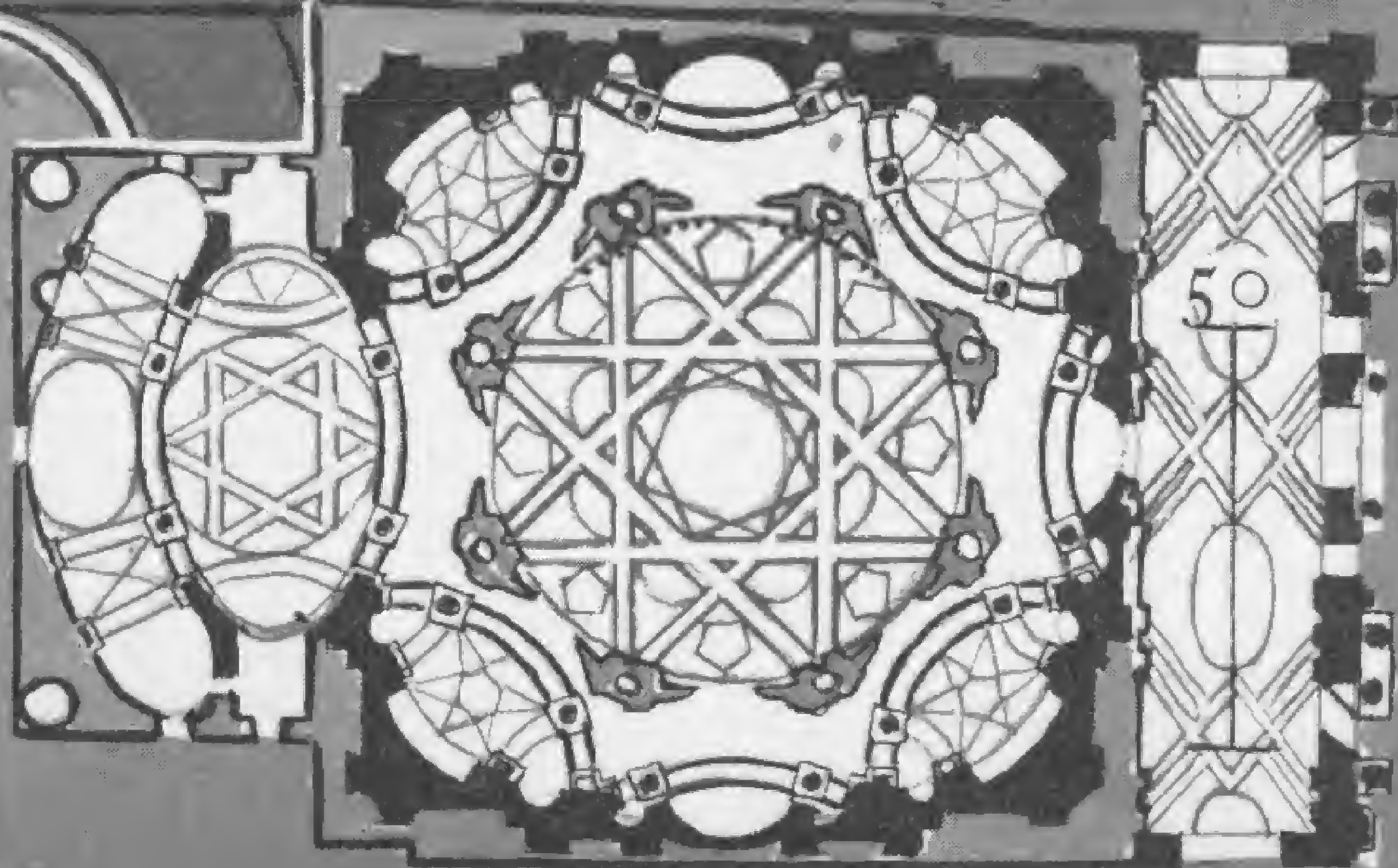
ITALY, CHURCHES



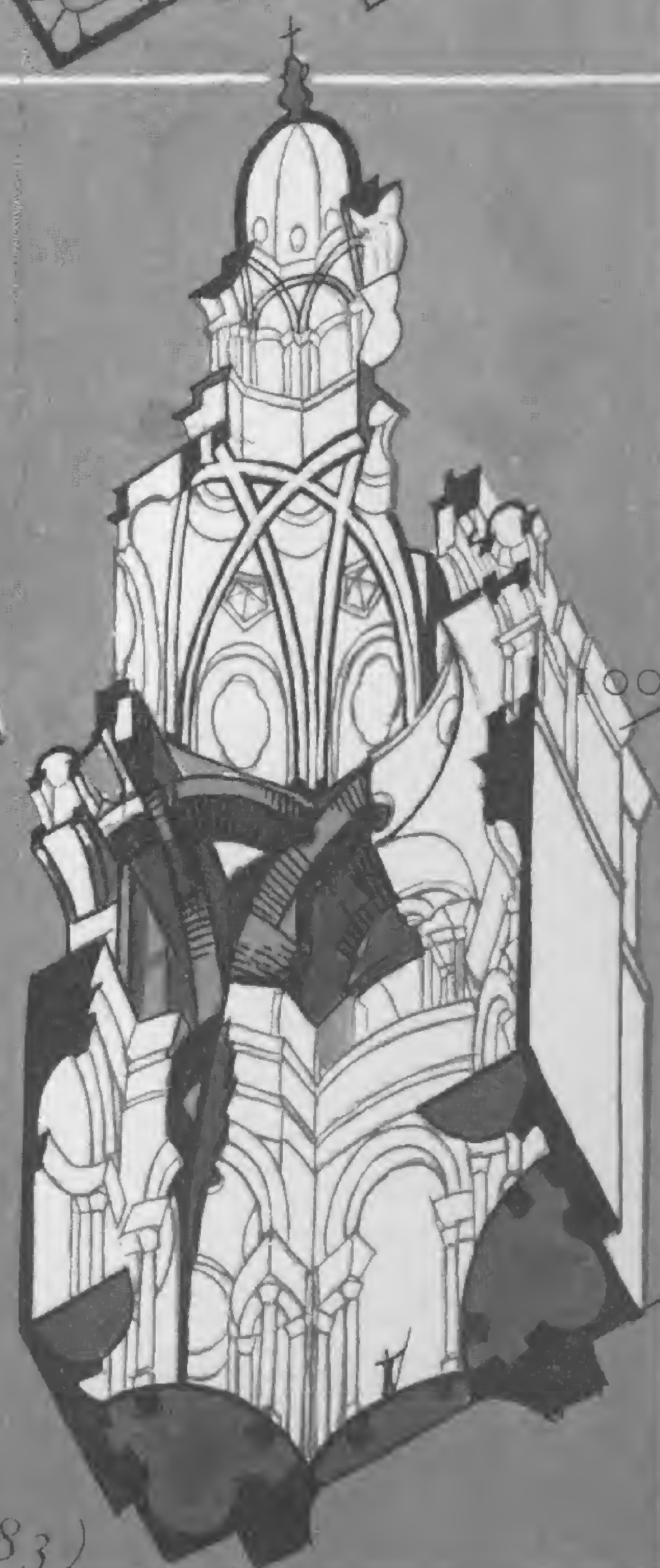
S. Carlo alle Quattro Fontane,
Rome, 1638-41
(Façade 1662-67, p.121)
Borromini (1599-1667)



Façade from *Dell'Architettura Civile*

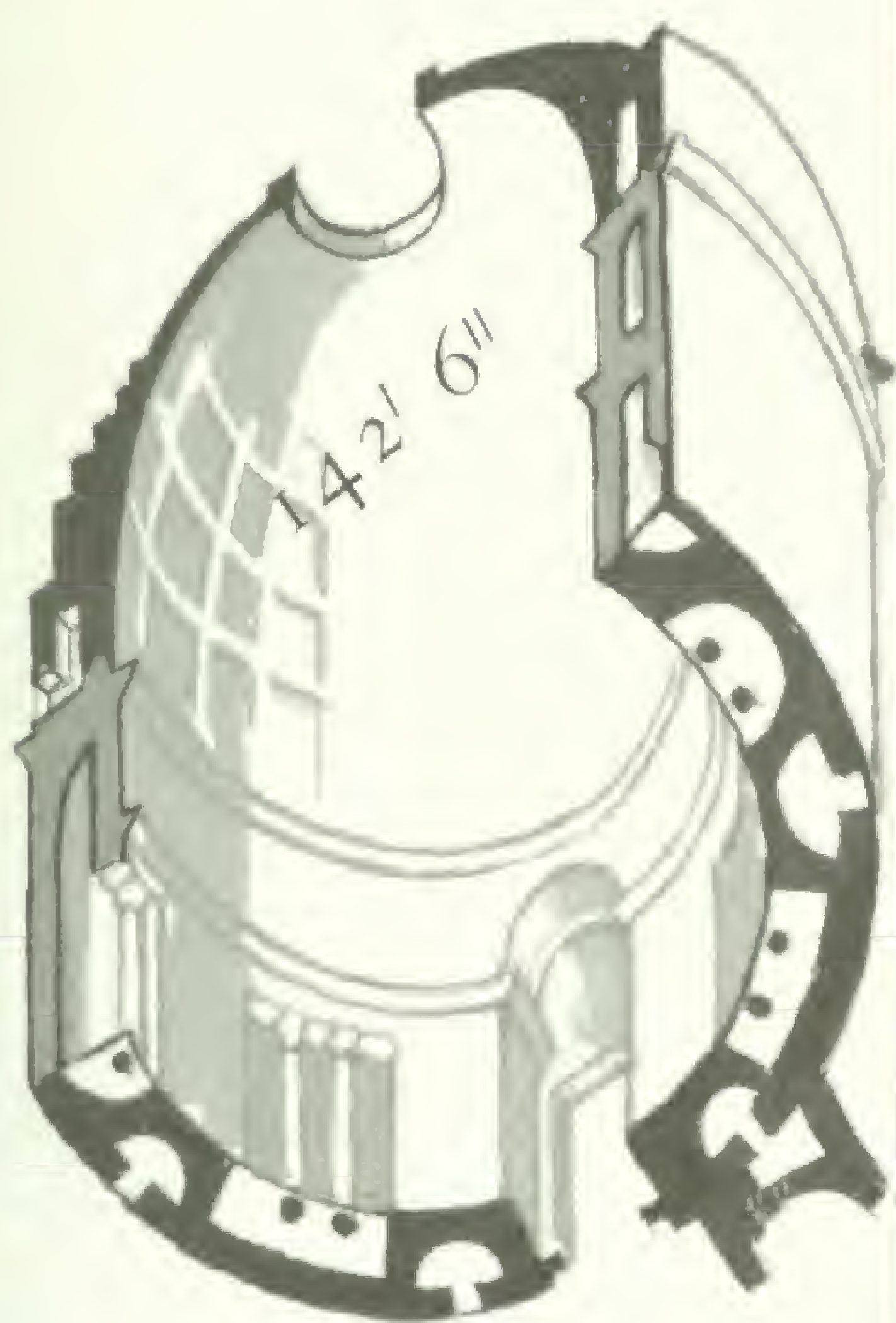


catenary
curve

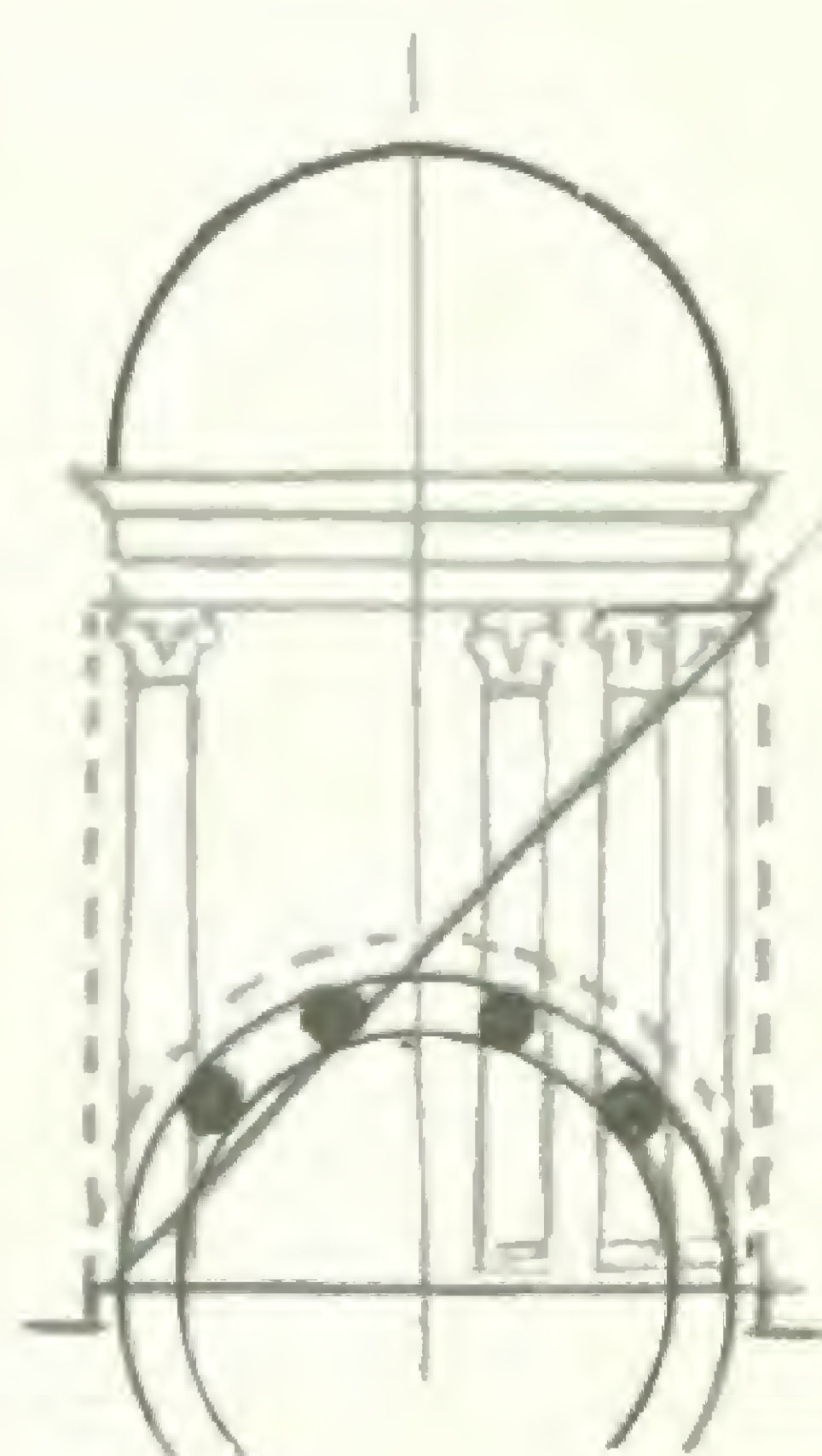
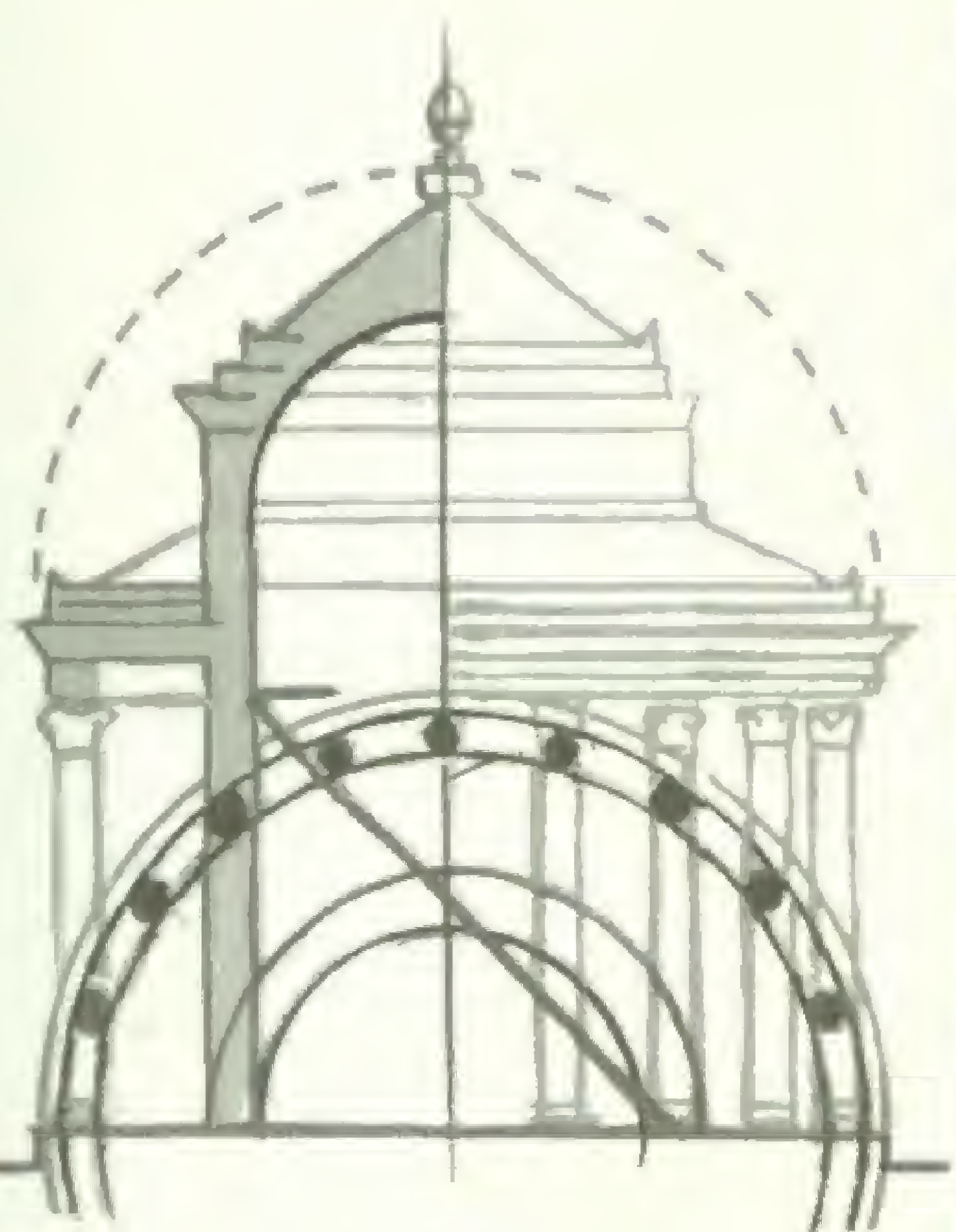


S. Lorenzo, Turin, 1668-87 *Guarini (1624-83)*

RENAISSANCE - BAROQUE



The Pantheon,
Rome, A.D. 120-124



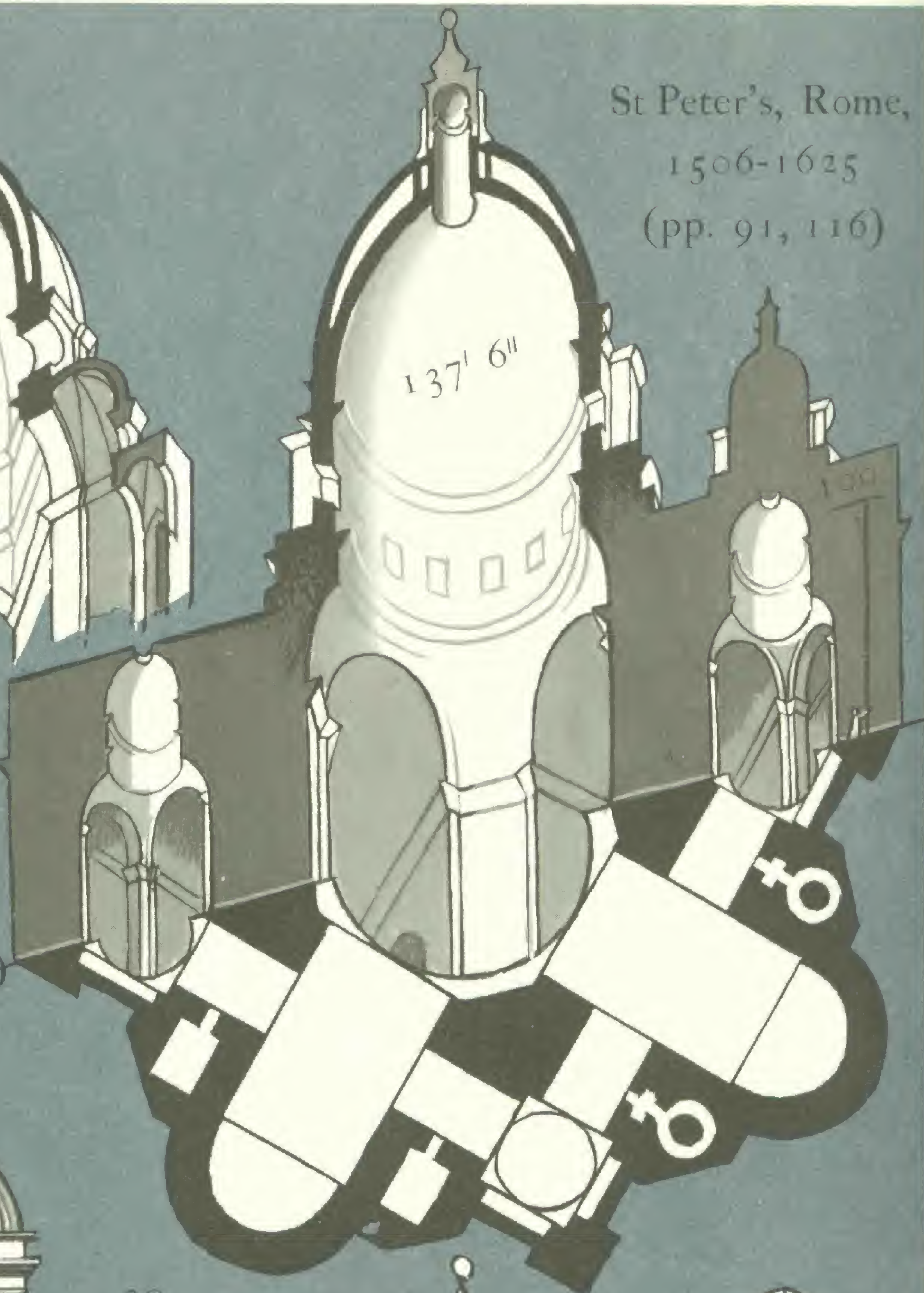
Circular temples,
Vitruvius (IV, 9)



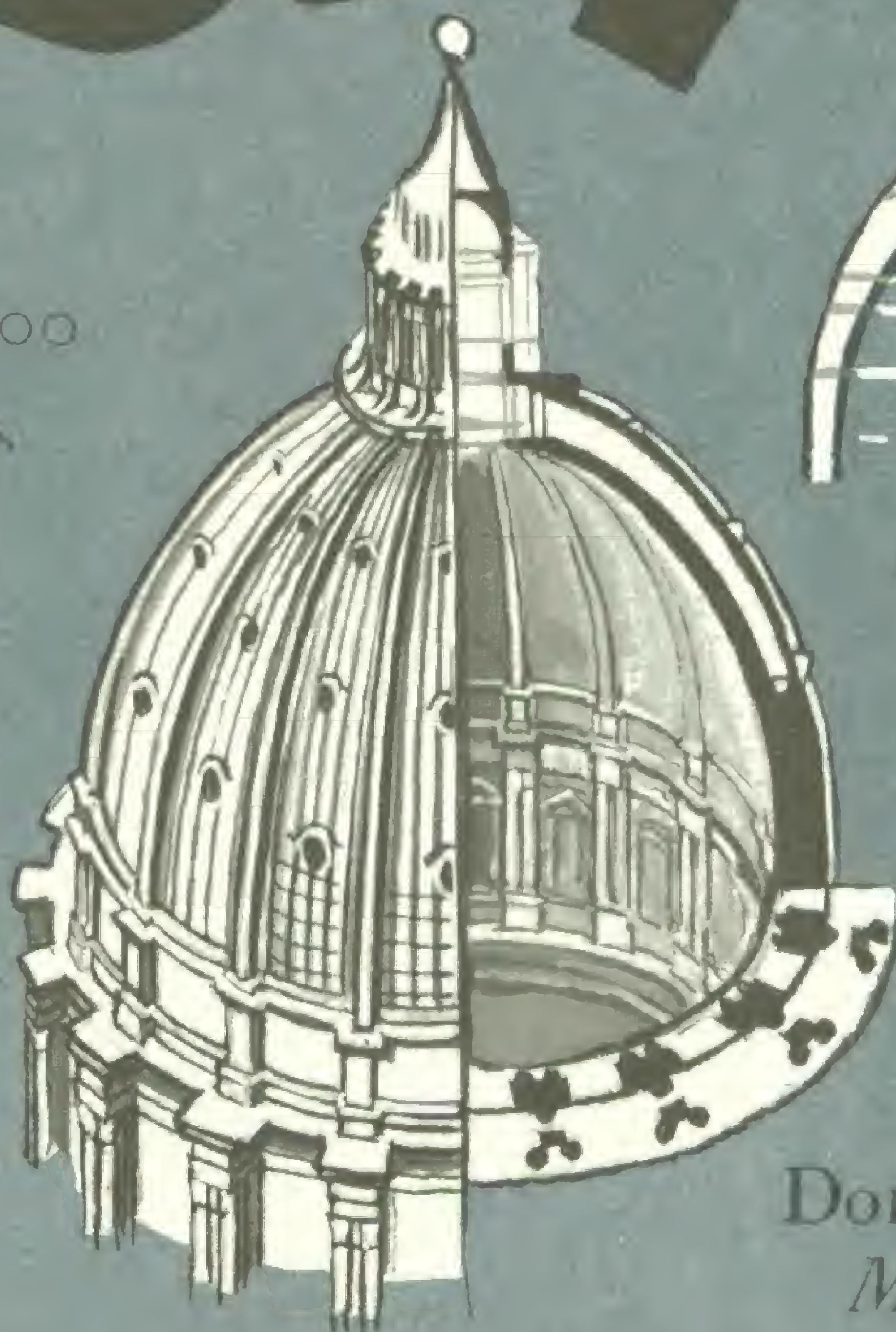
Florence
Cathedral:
Rome, 1420-34
Brunelleschi
(1377-1446)
(pp. 91, 109, 116)



Tempietto, S. Pietro in
Montorio, Rome, 1502-10
Bramante (1444-1514)



St Peter's, Rome,
1506-1625
(pp. 91, 116)



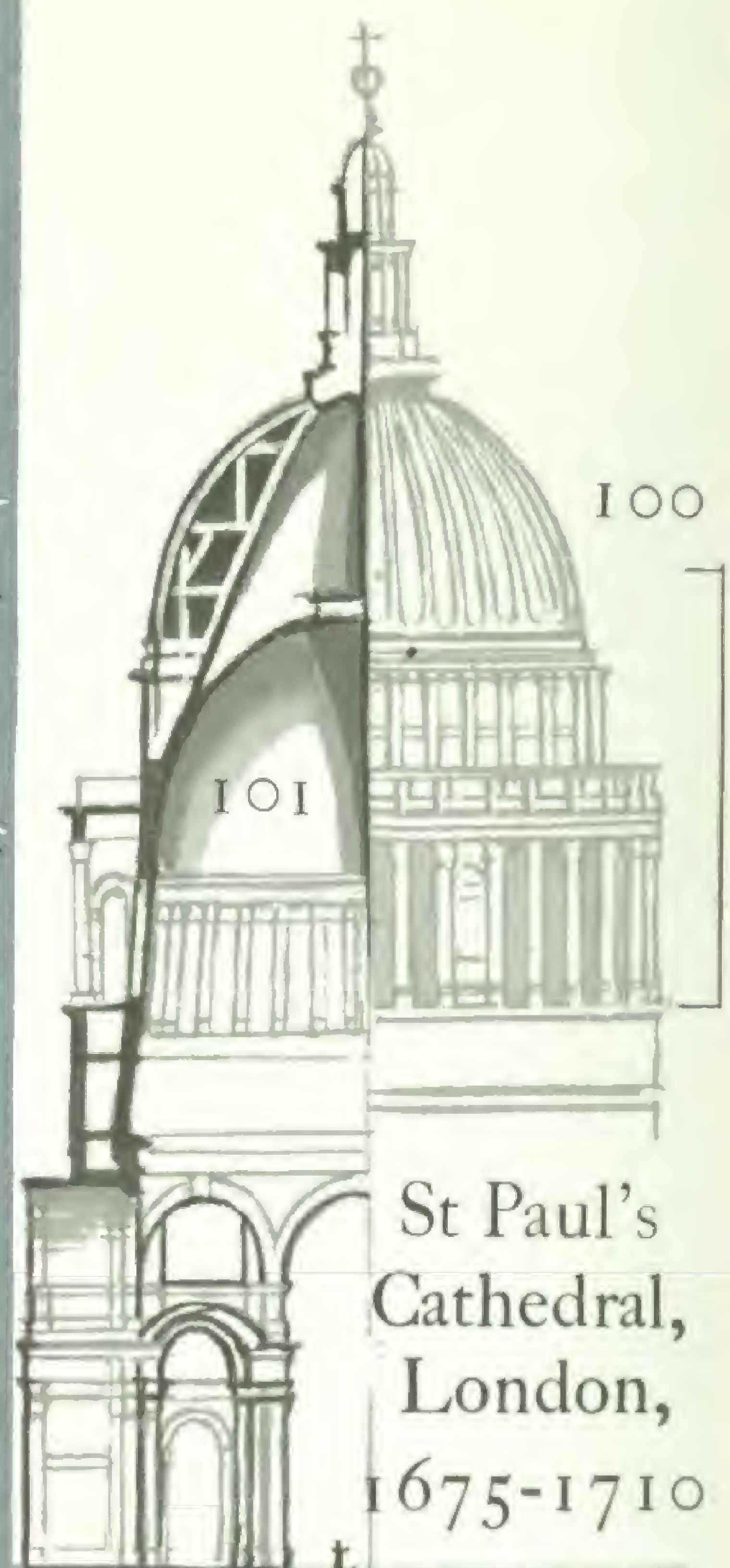
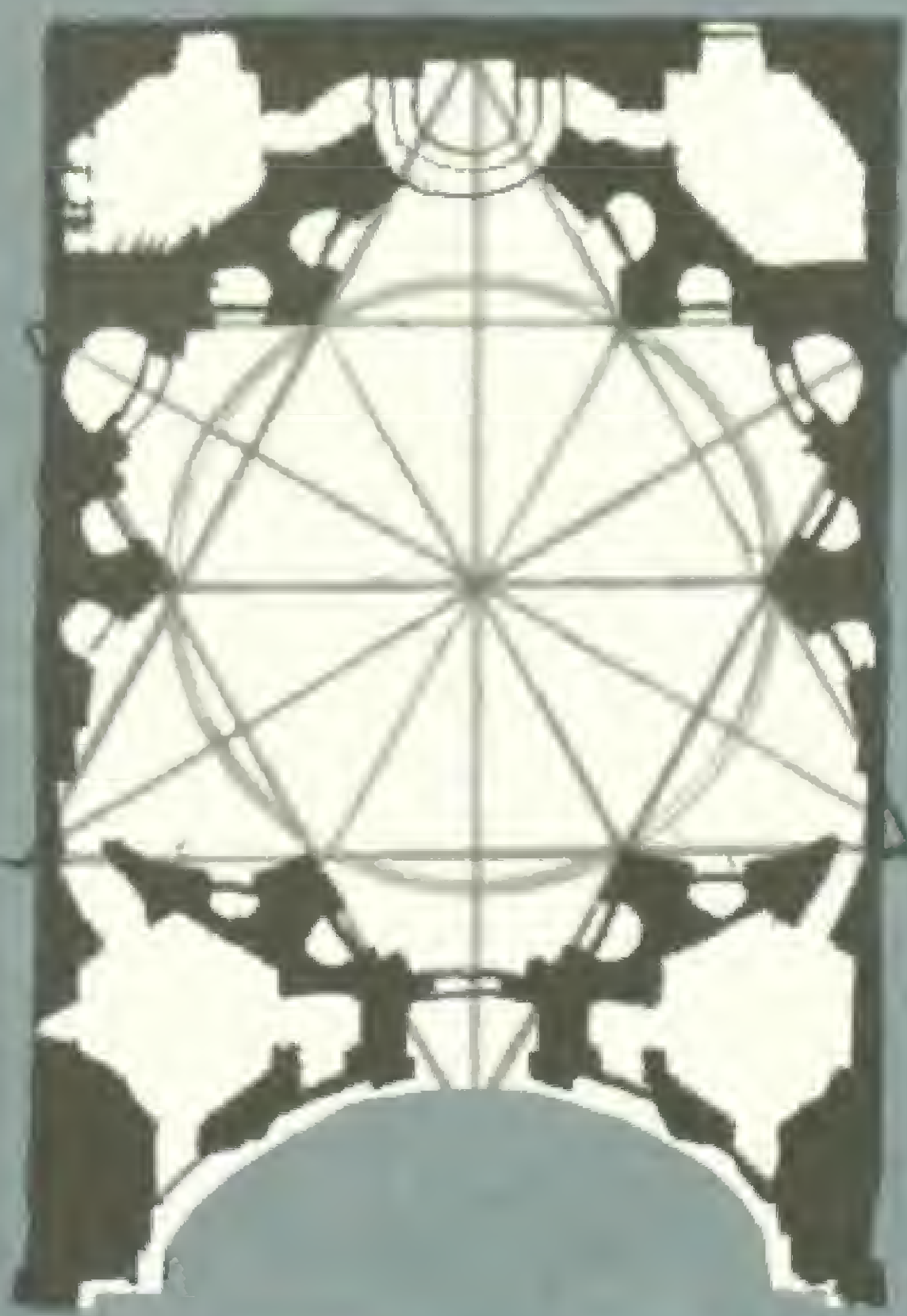
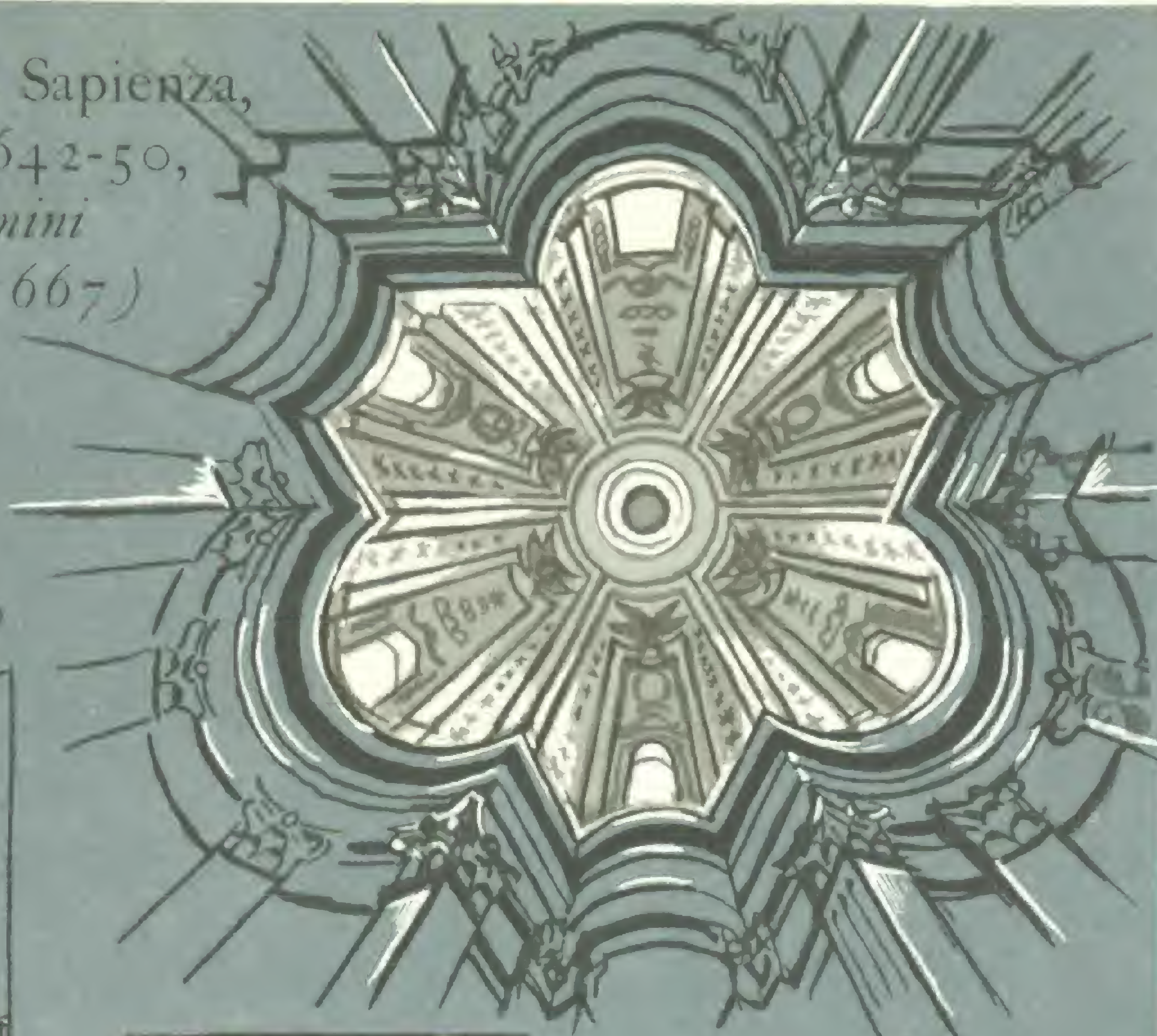
Dome 1564-90
Michelangelo
(1475-1564)



c. chains

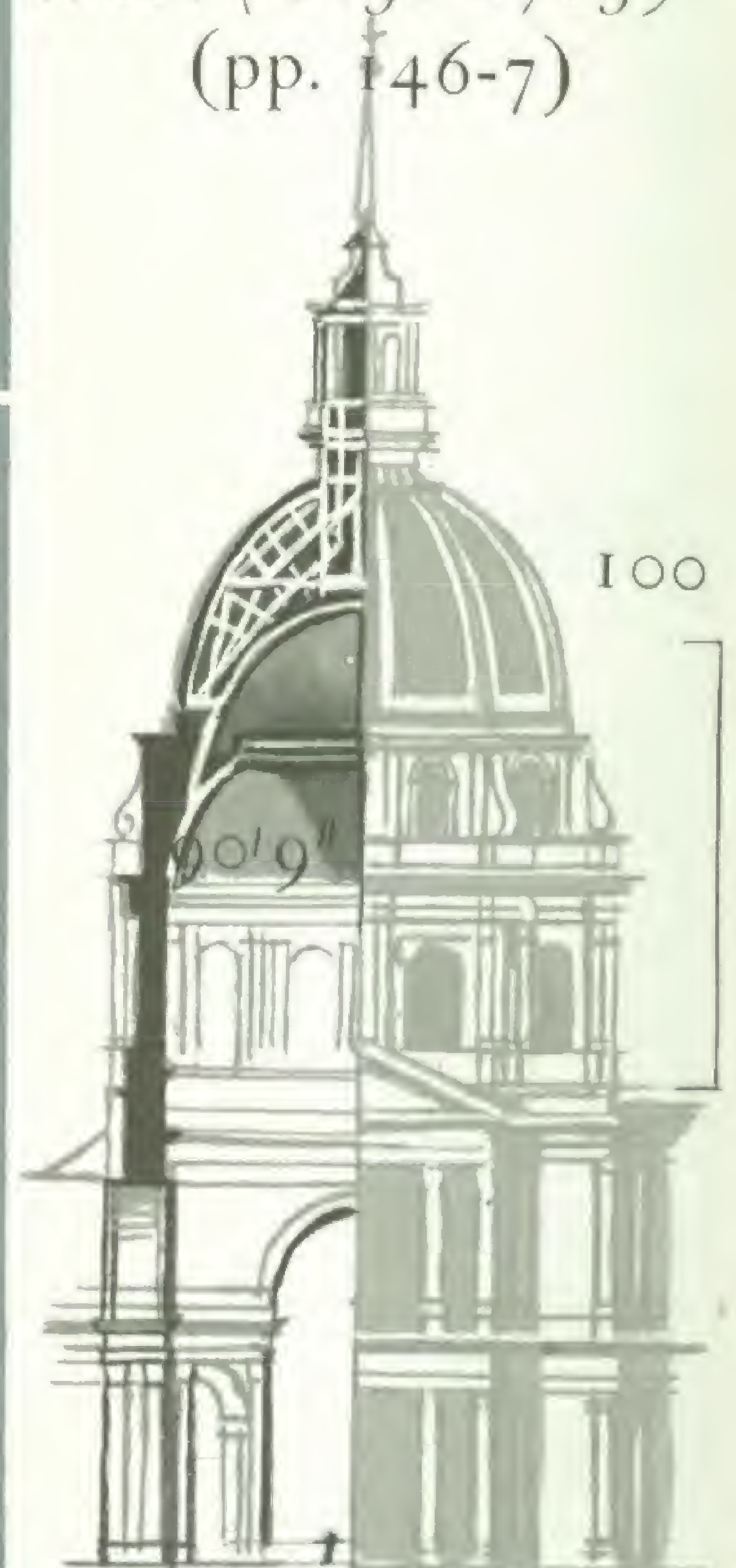
ITALY, DOMES

S. Ivo della Sapienza,
Rome, 1642-50,
Borromini
(1599-1667)

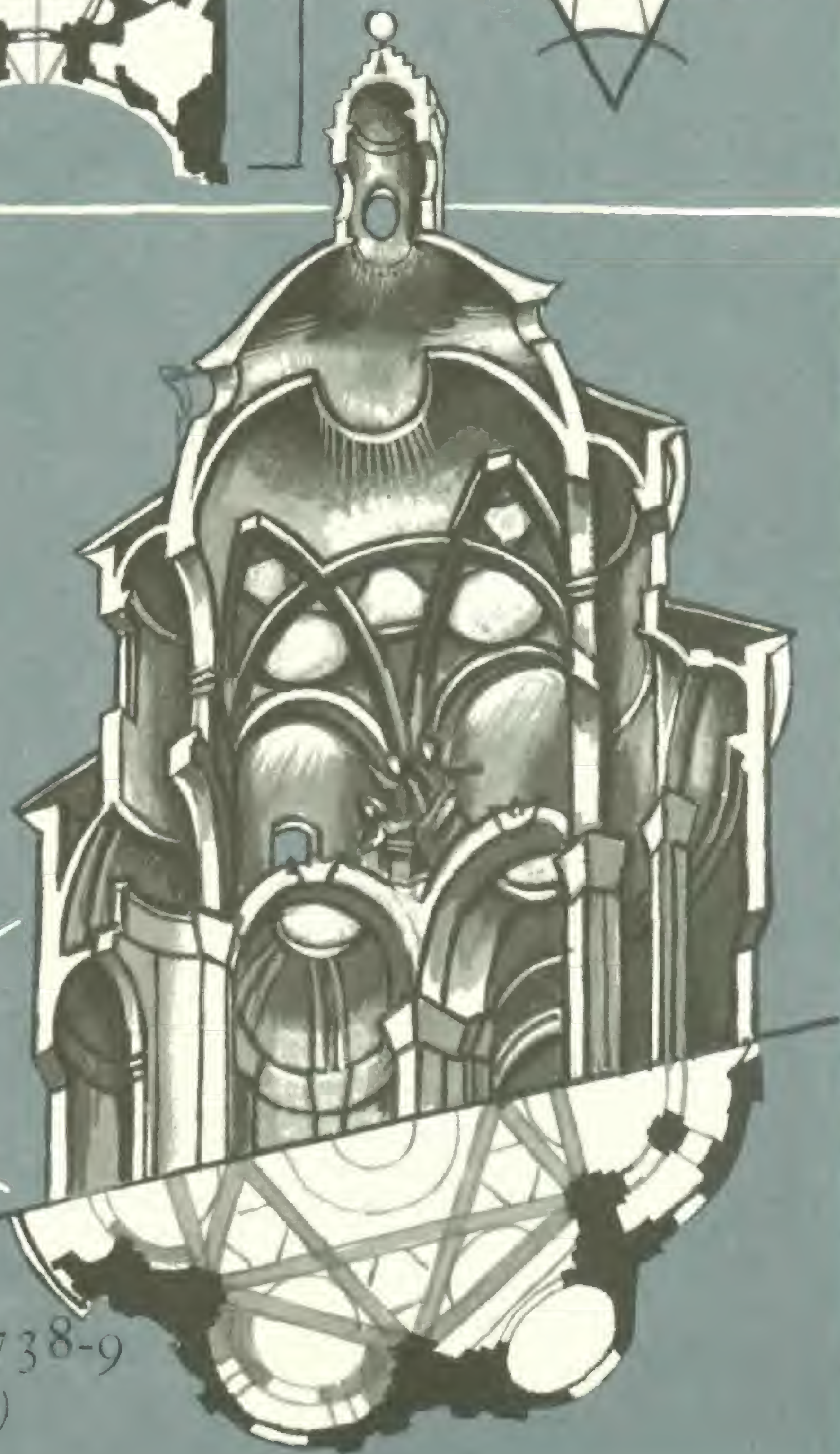


St Paul's
Cathedral,
London,
1675-1710

Wren (1631-1723)
(pp. 146-7)

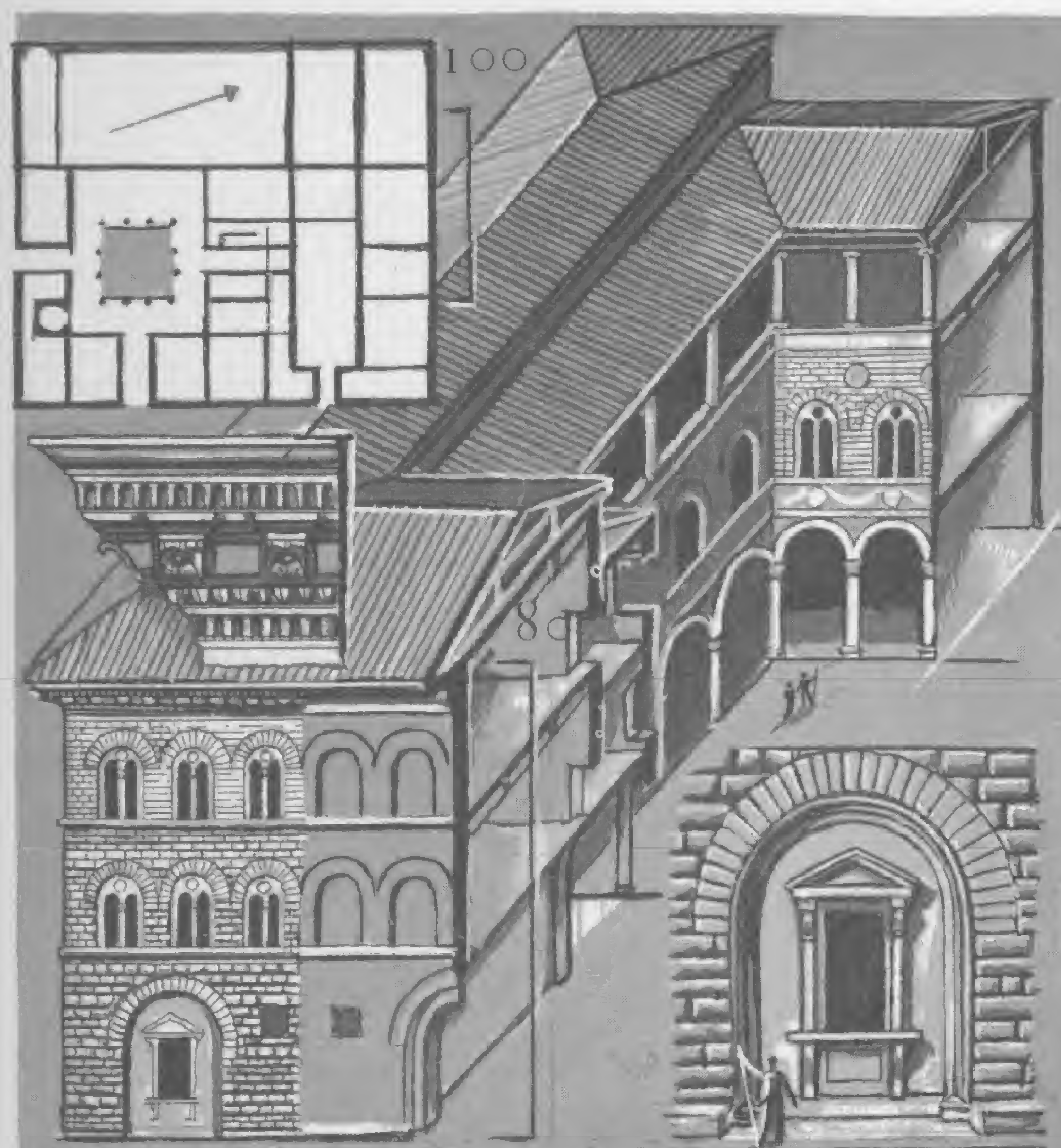


The Dome of the
Invalides, Paris,
1693-1706 *Jules
Hardouin-Mansart*
(1646-1708)
(p. 131)

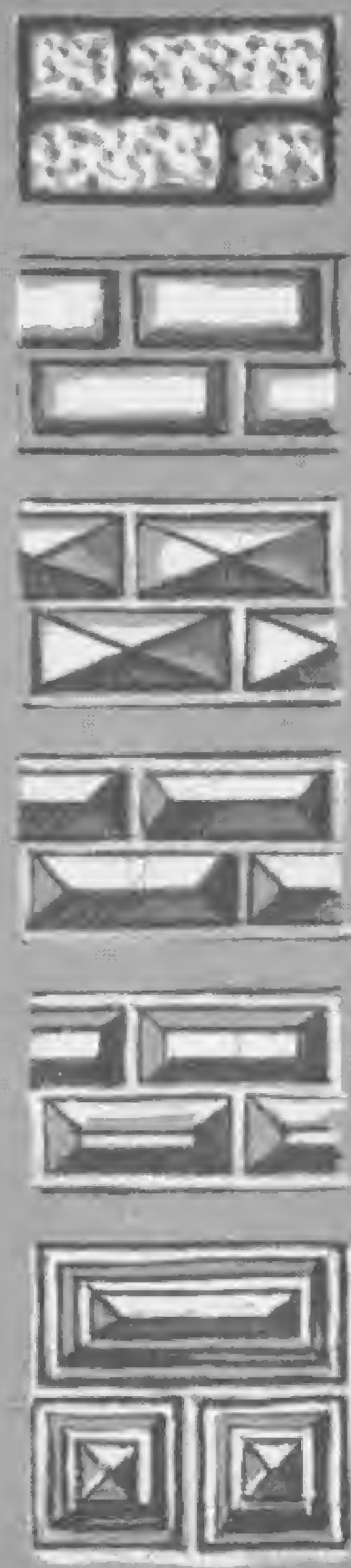


Sanctuary, Vallinotto, near Turin, 1738-9
Bernard Vittone (1704/5-70)

RENAISSANCE - BAROQUE



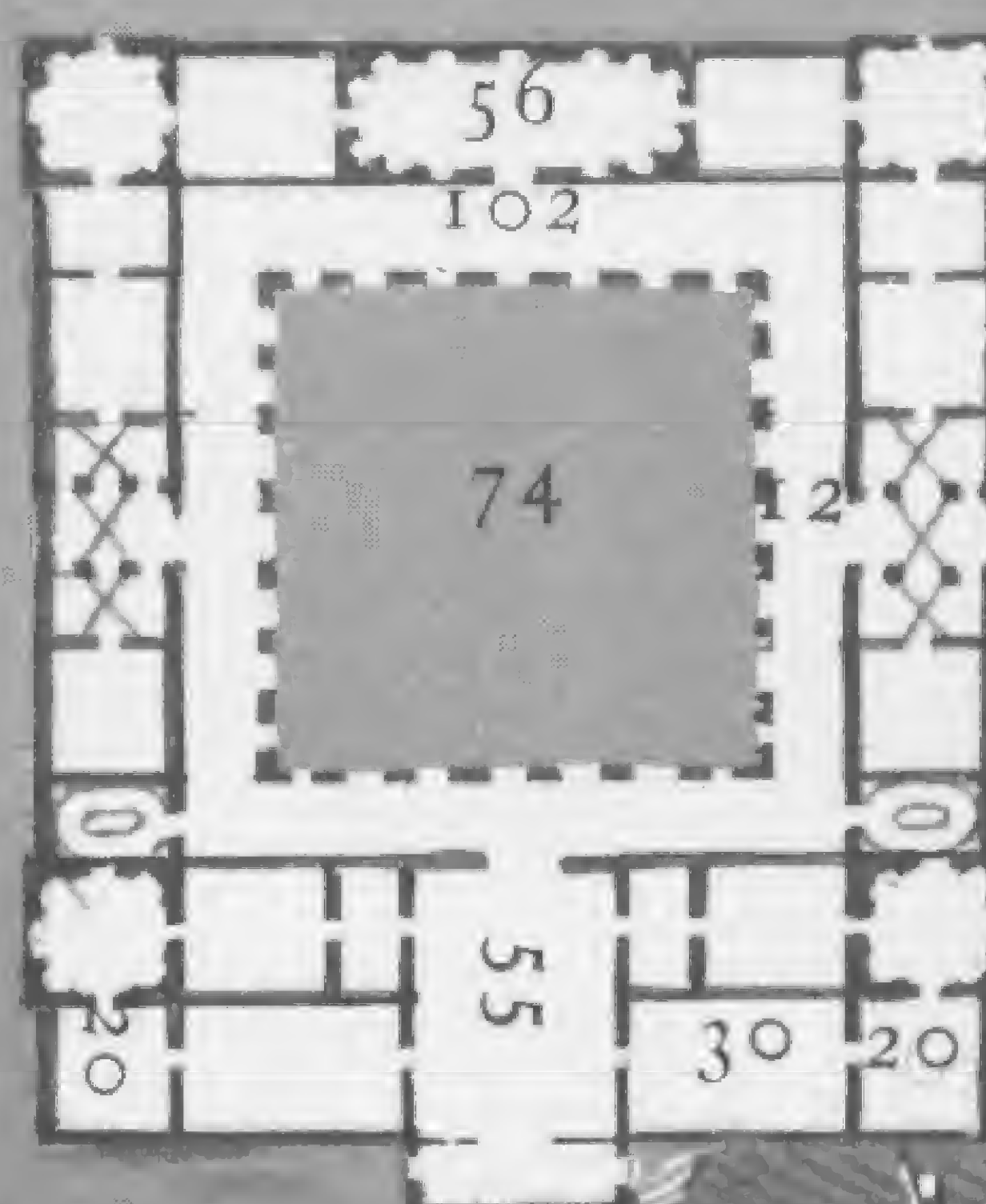
Palazzo Medici-Riccardi, Florence, 1430
Michelozzo (1397-1473)



rusticated
masonry
after
Serlio



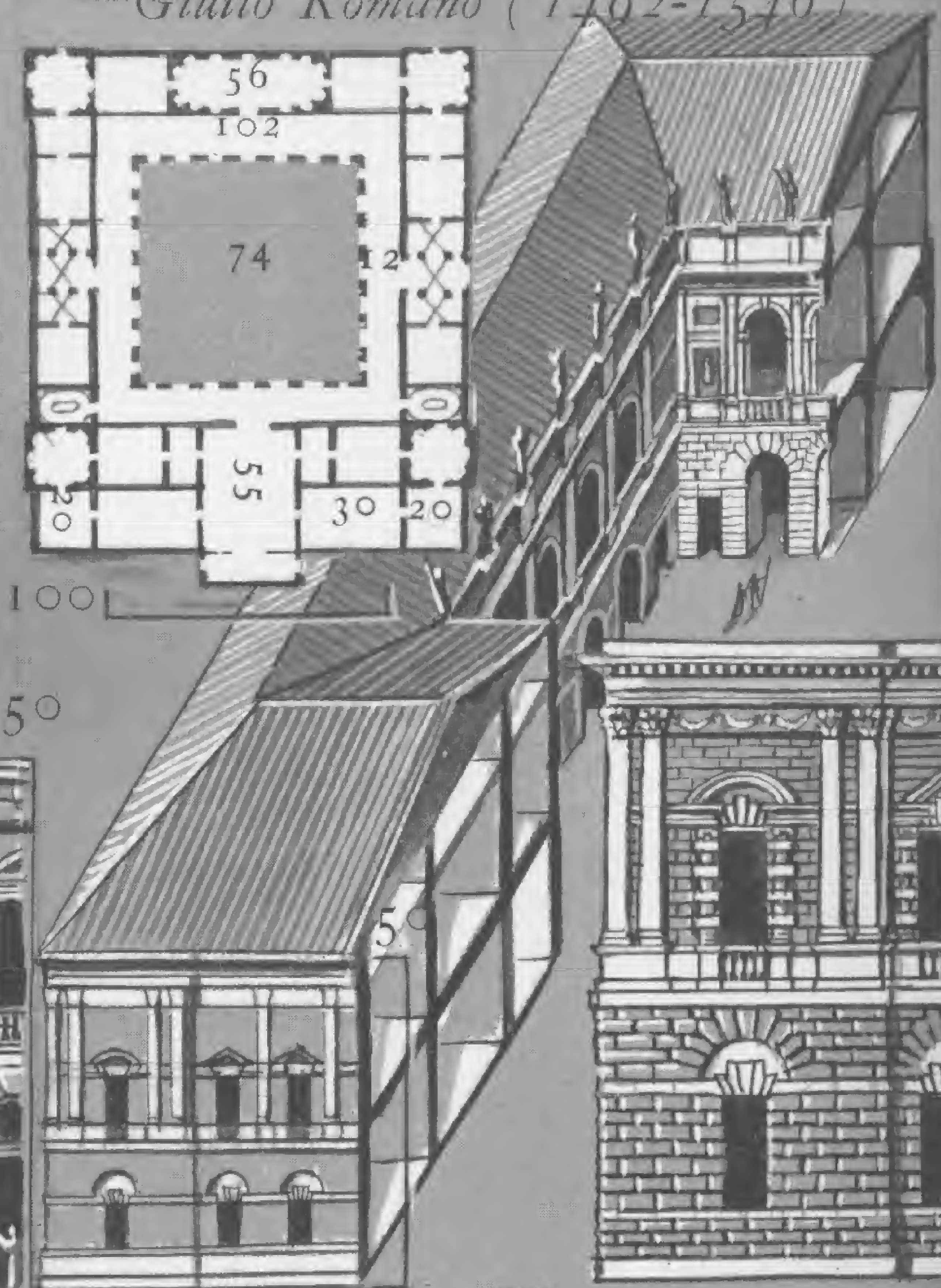
Palazzo del Tè, Mantua, 1526-35
Giulio Romano (1492-1546)



Doric Ionic Corinthia



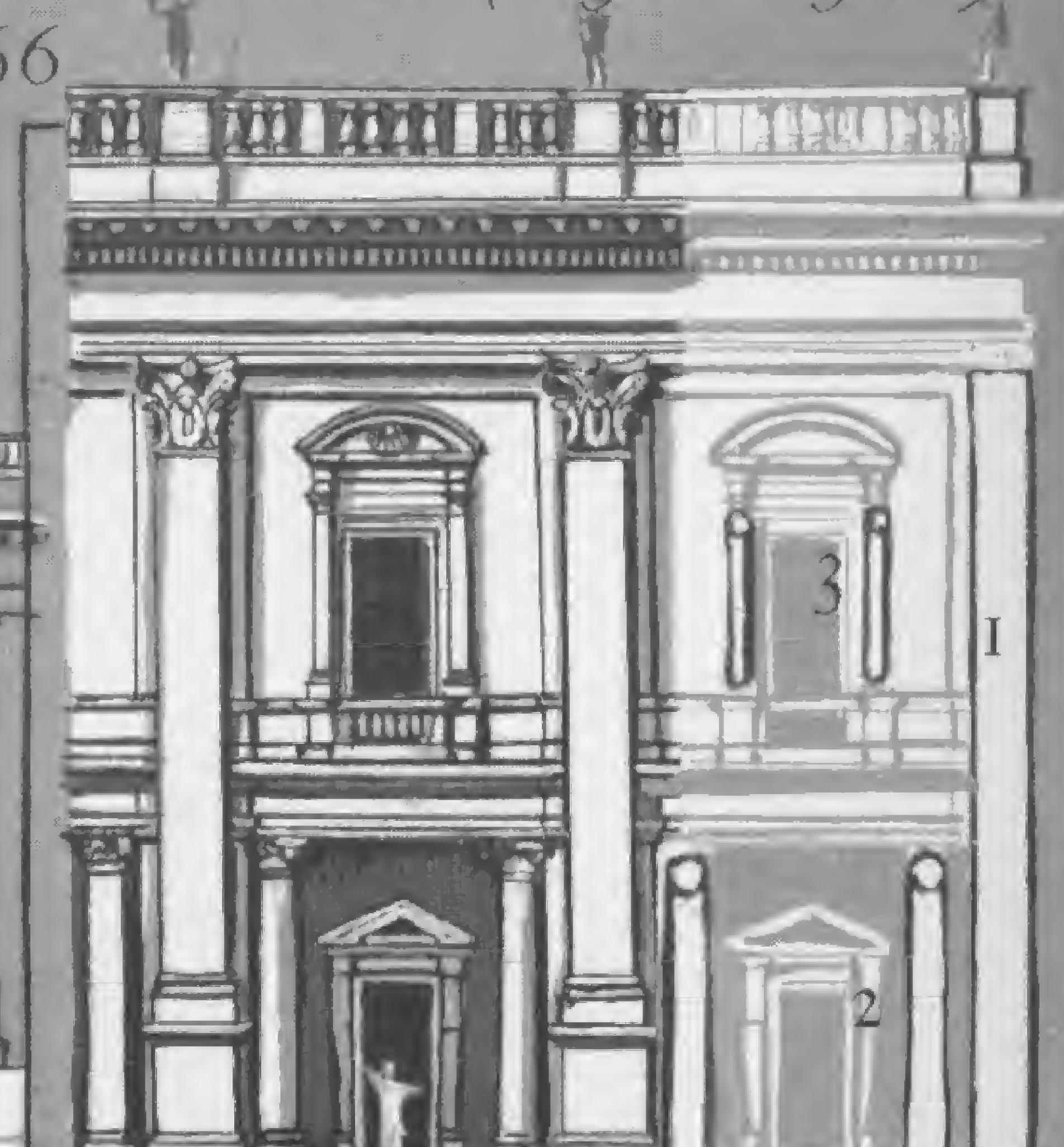
Palazzo Rucellai, Cancelleria, Rome, House of Raphael, Florence, 1451
Alberti (1404-72)



Palazzo Thiene, Vicenza, 1556-58
Andrea Palladio (1508-1580)

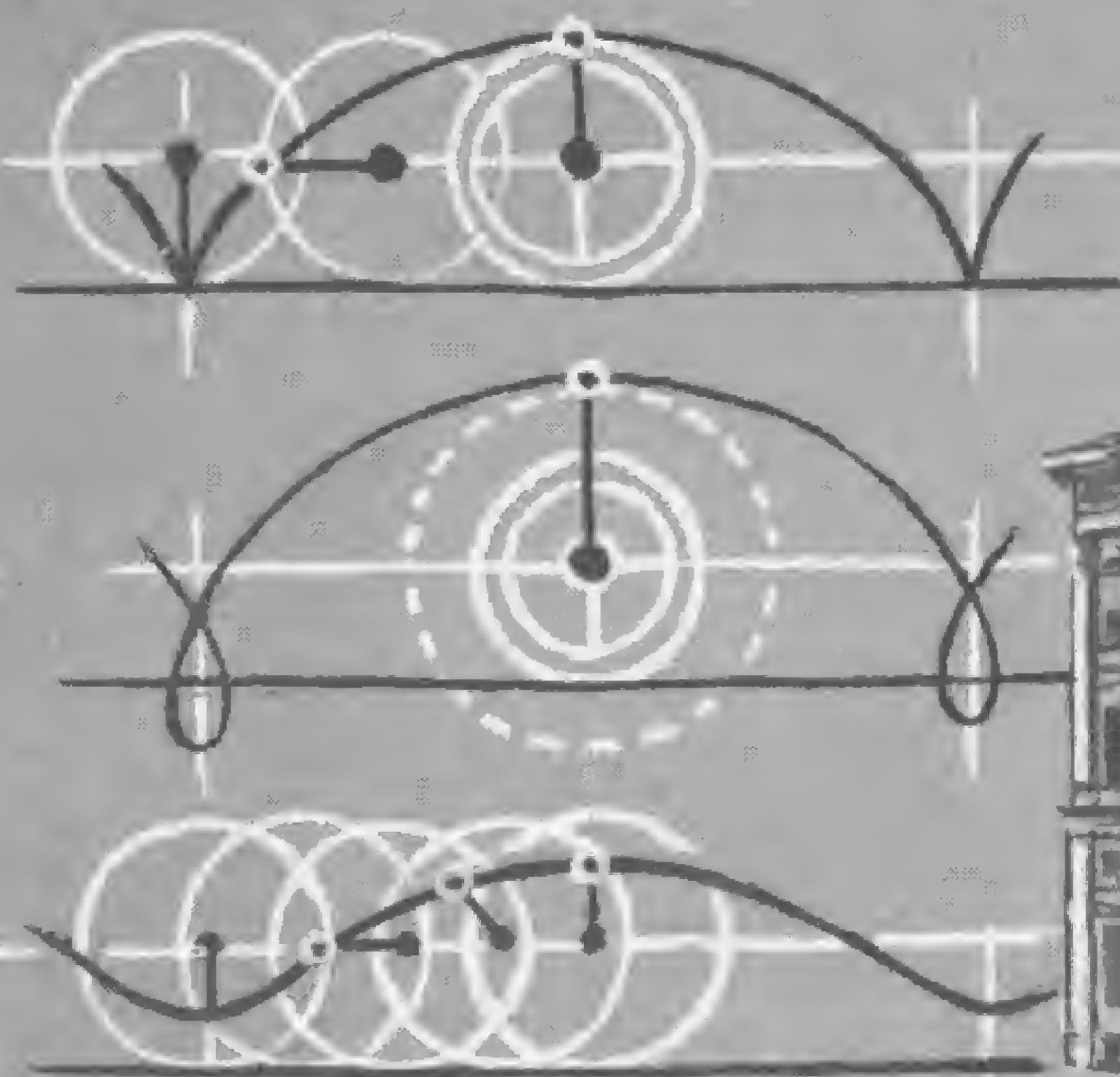
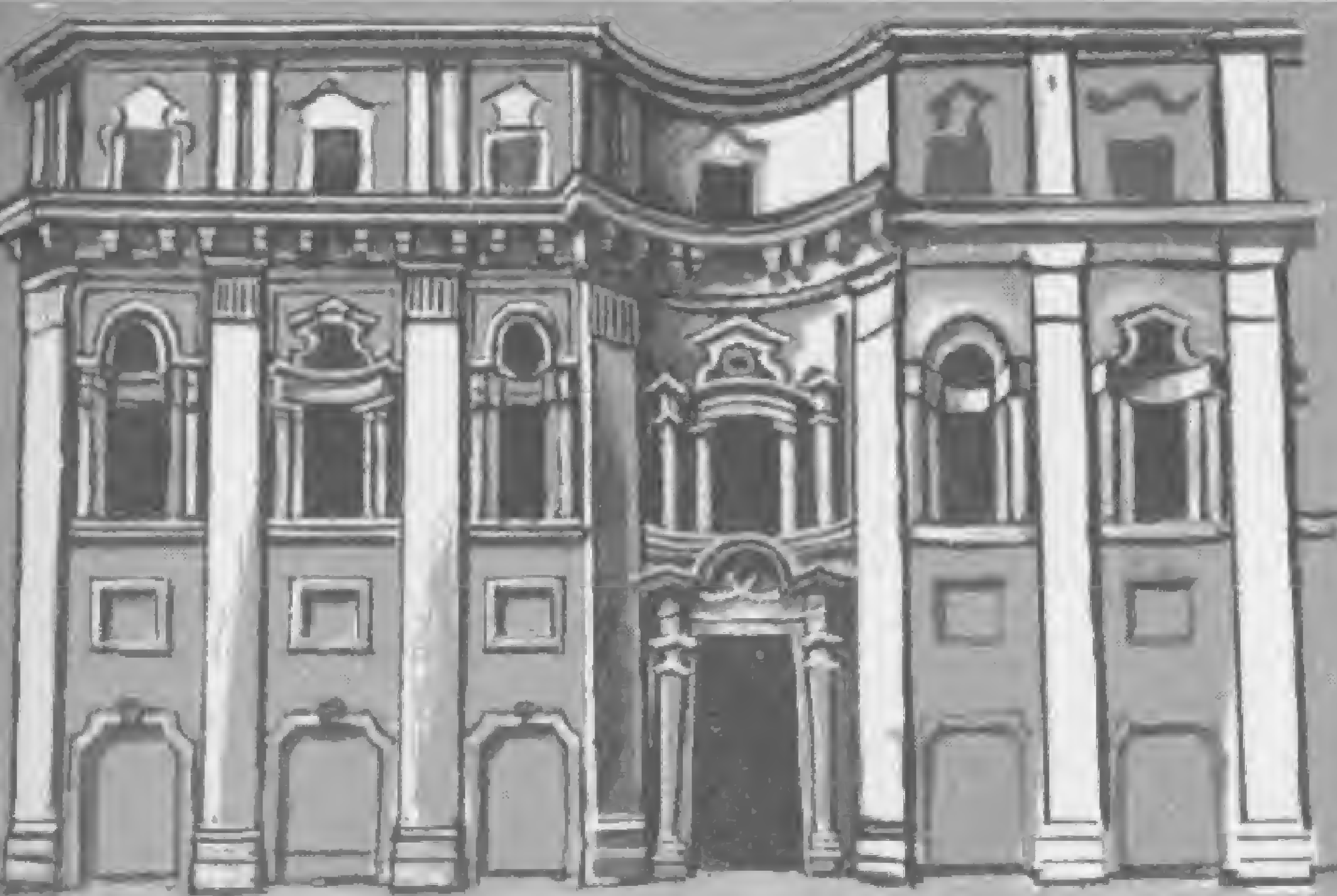


The Capitol, Rome, 1540-1644, *Michelangelo (1475-1564)*

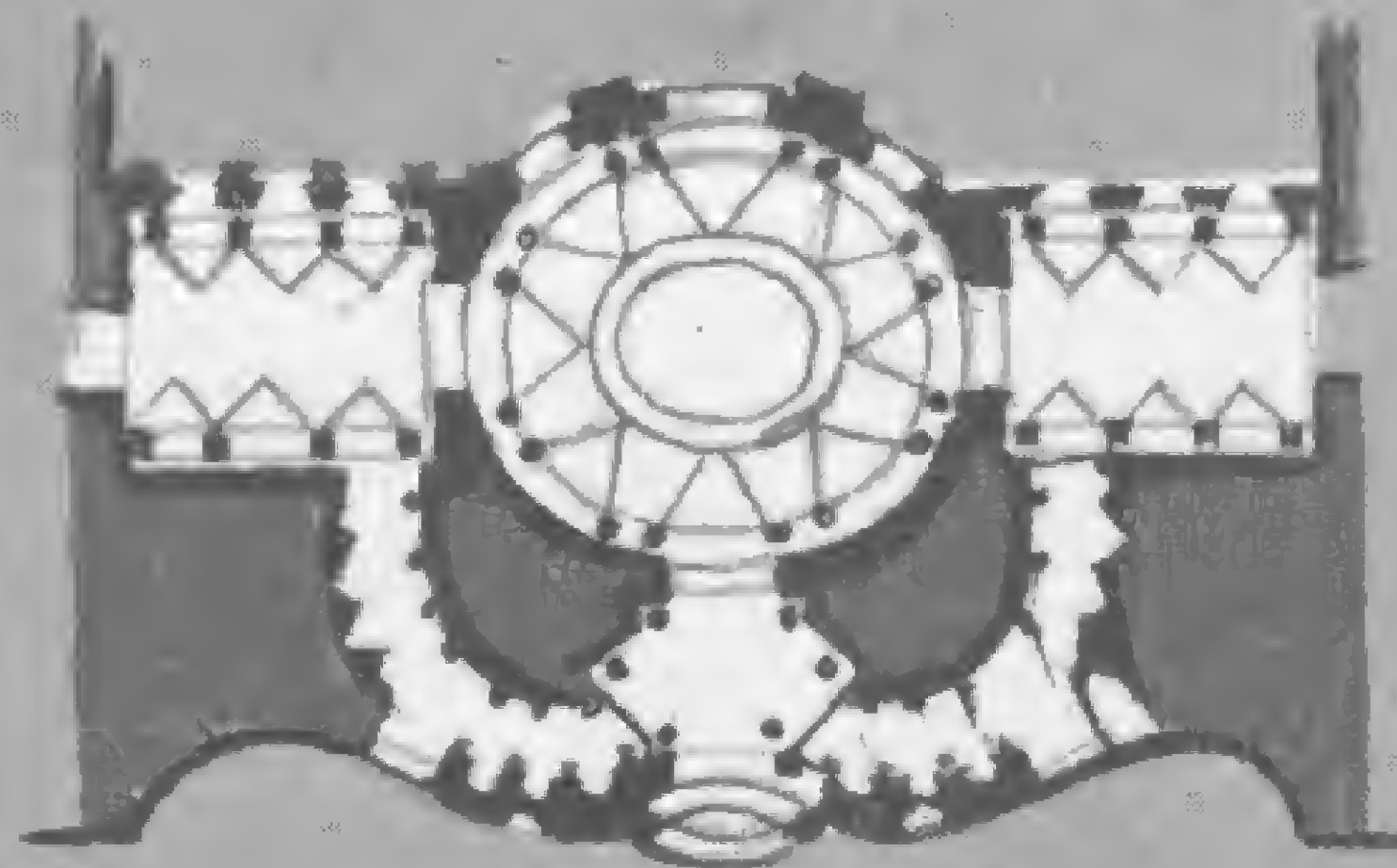


The 'Colossal' Order

ITALY, PALACES

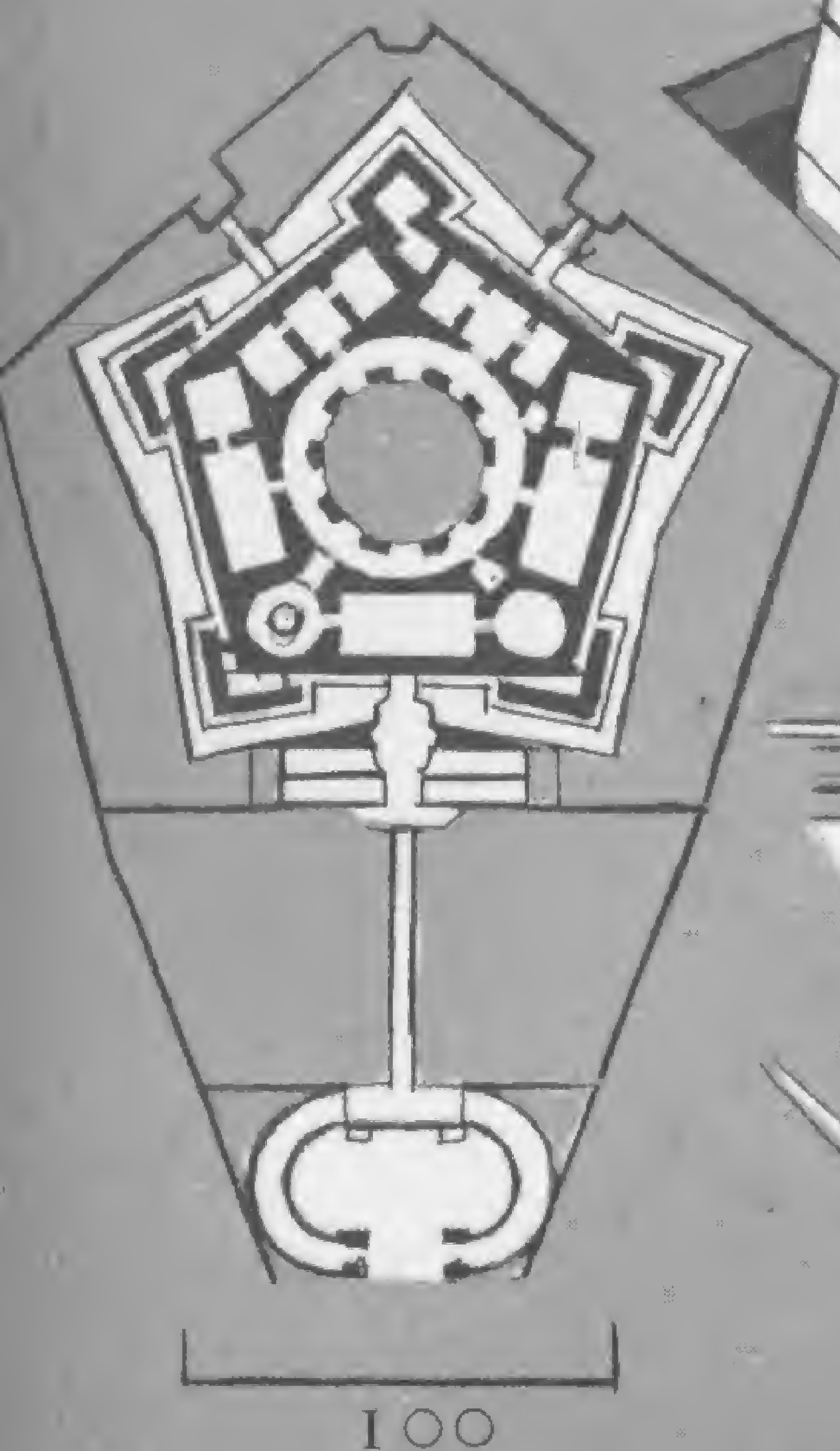


cycloidal curves
Pascal (1623-1662)

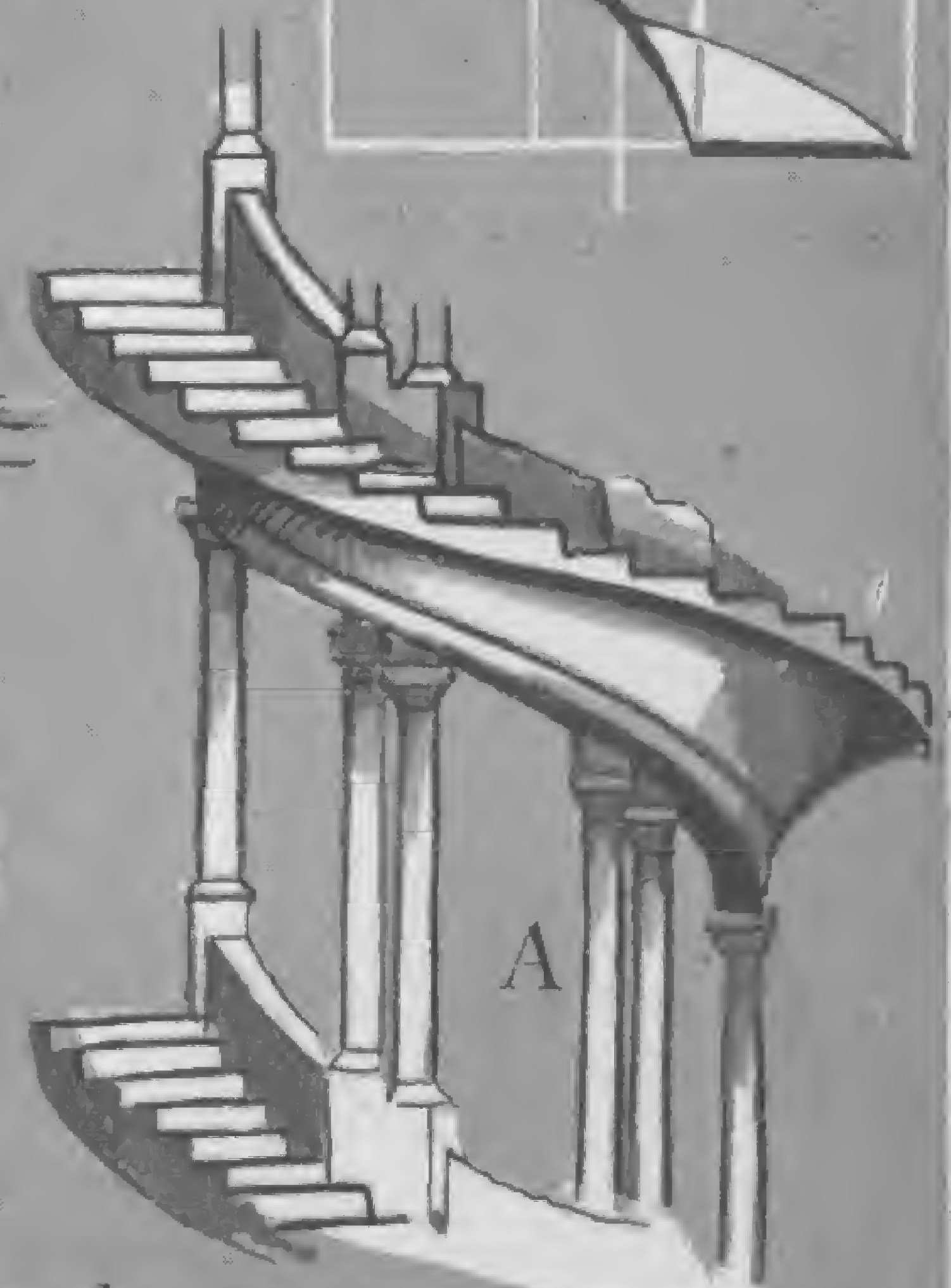
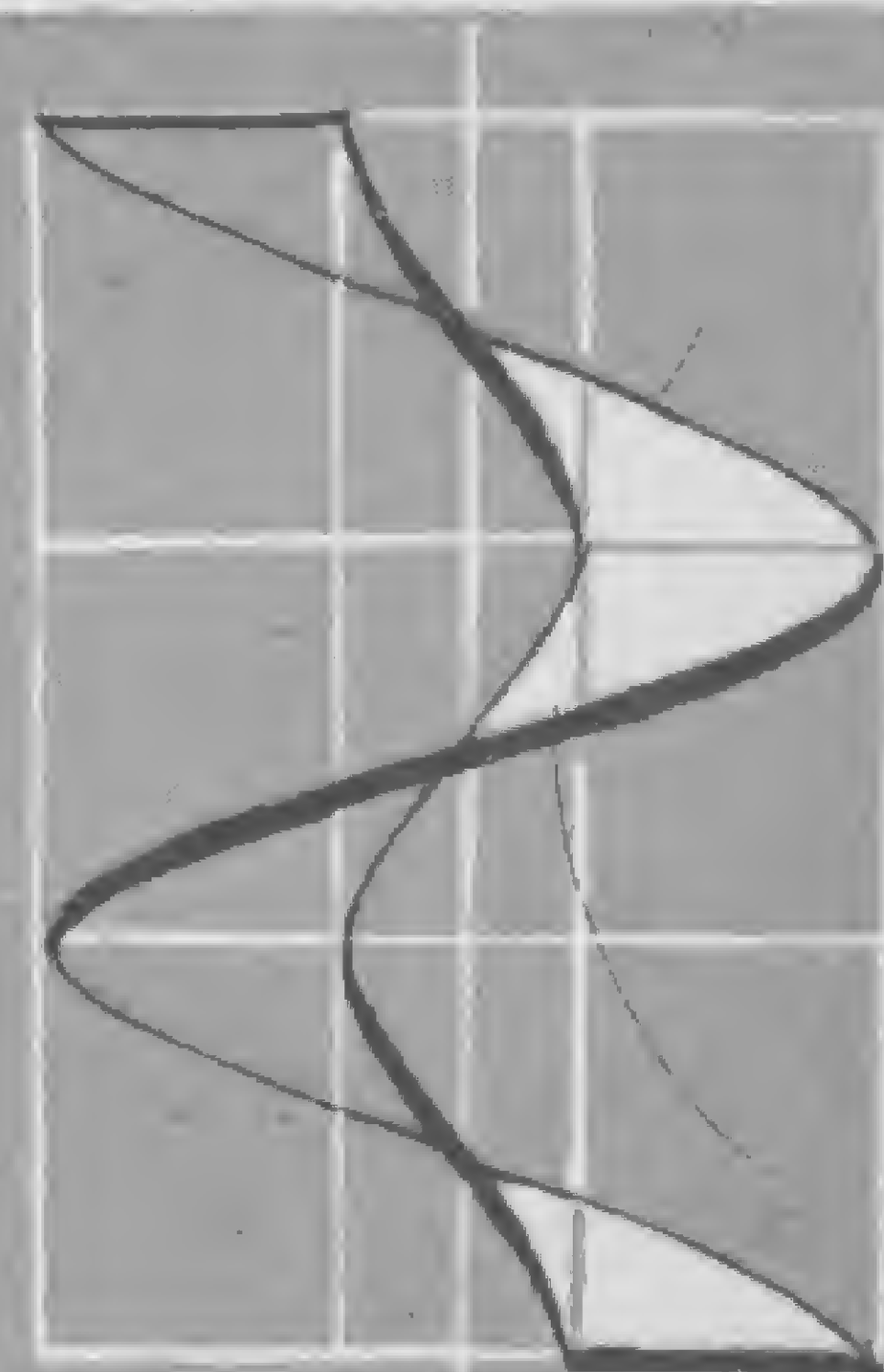


Collegio Propaganda
Fide, Rome 1646-66
Borromini (1599-1667)

Palazzo Carignano,
Turin, c.1678-80
Guarini (1624-1683)



100



A

Palazzo Farnese, Caprarola, 1559-1564 *Giacomo Barozzi da Vignola (1507-1573)*

RENAISSANCE-BAROQUE



(p. 117)



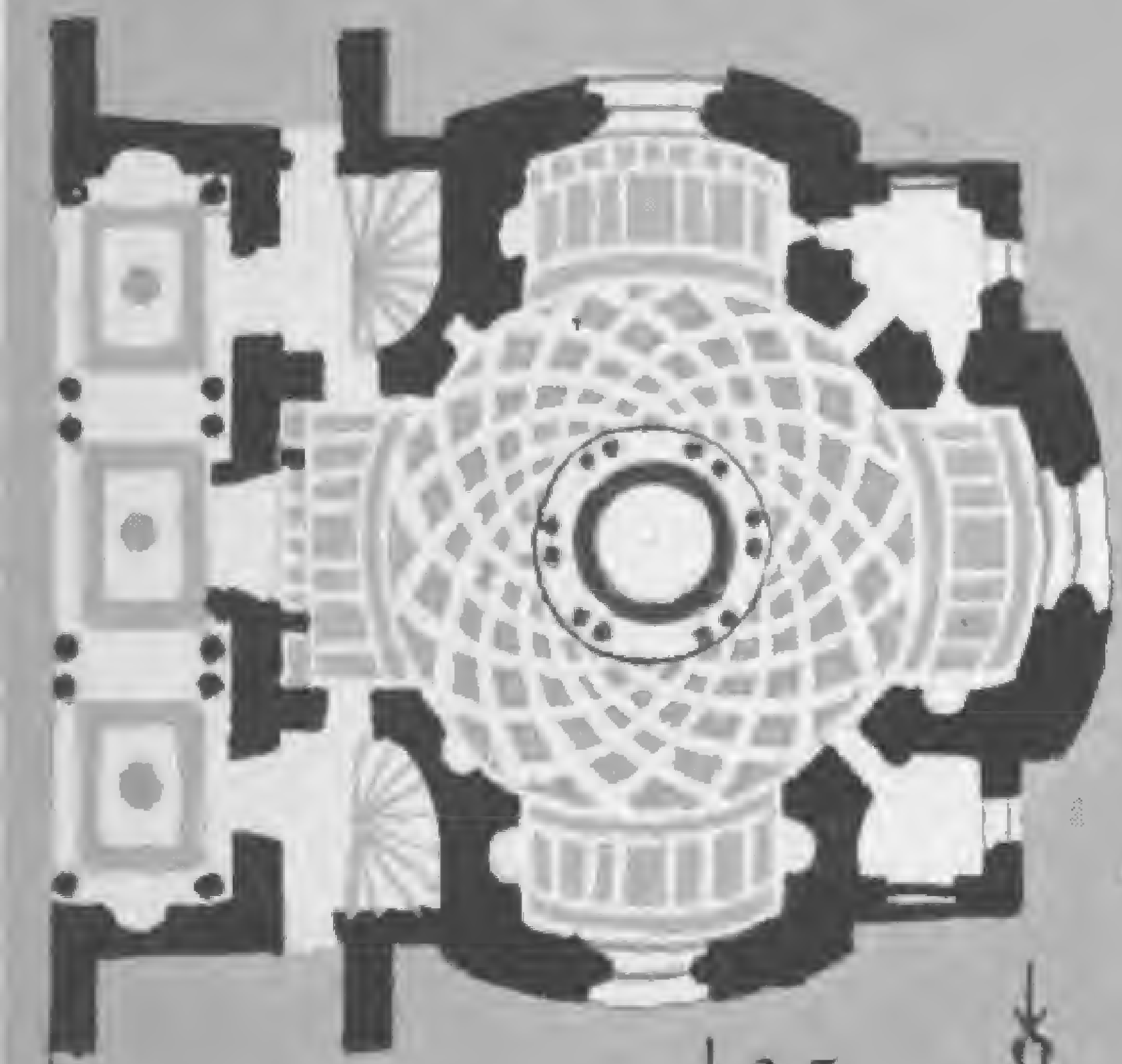
after Serlio
1537



150

50

St Gervais, Paris:
façade, 1616
Salomon de Brosse
(c. 1562-1626)



25

50



Château d'Anet: chapel, 1549-53
Philibert de l'Orme (c. 1510-1570)



Church of the Sorbonne, Paris, c. 1635
Jacques Lemercier (c. 1580/5-1654)

The Italian campaigns of the French Kings, Charles VIII (1483-98), Louis XII (1498-1515) and Francis I (1515-47), failed in their aims; instead France was invaded by the ideas and the arts of the Italian Renaissance.

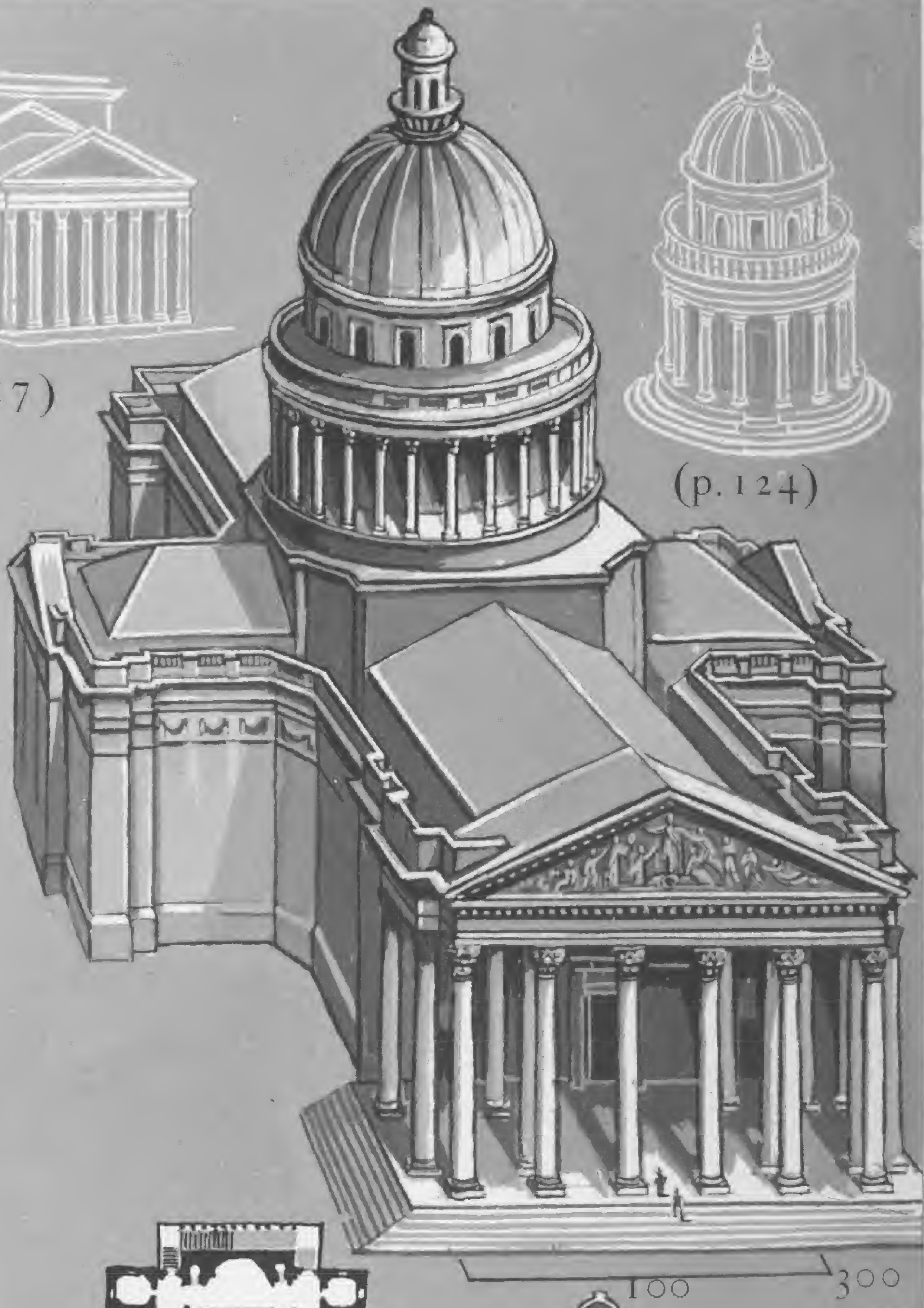
FRANCE, CHURCHES



(pp. 56, 117)



(p. 124)

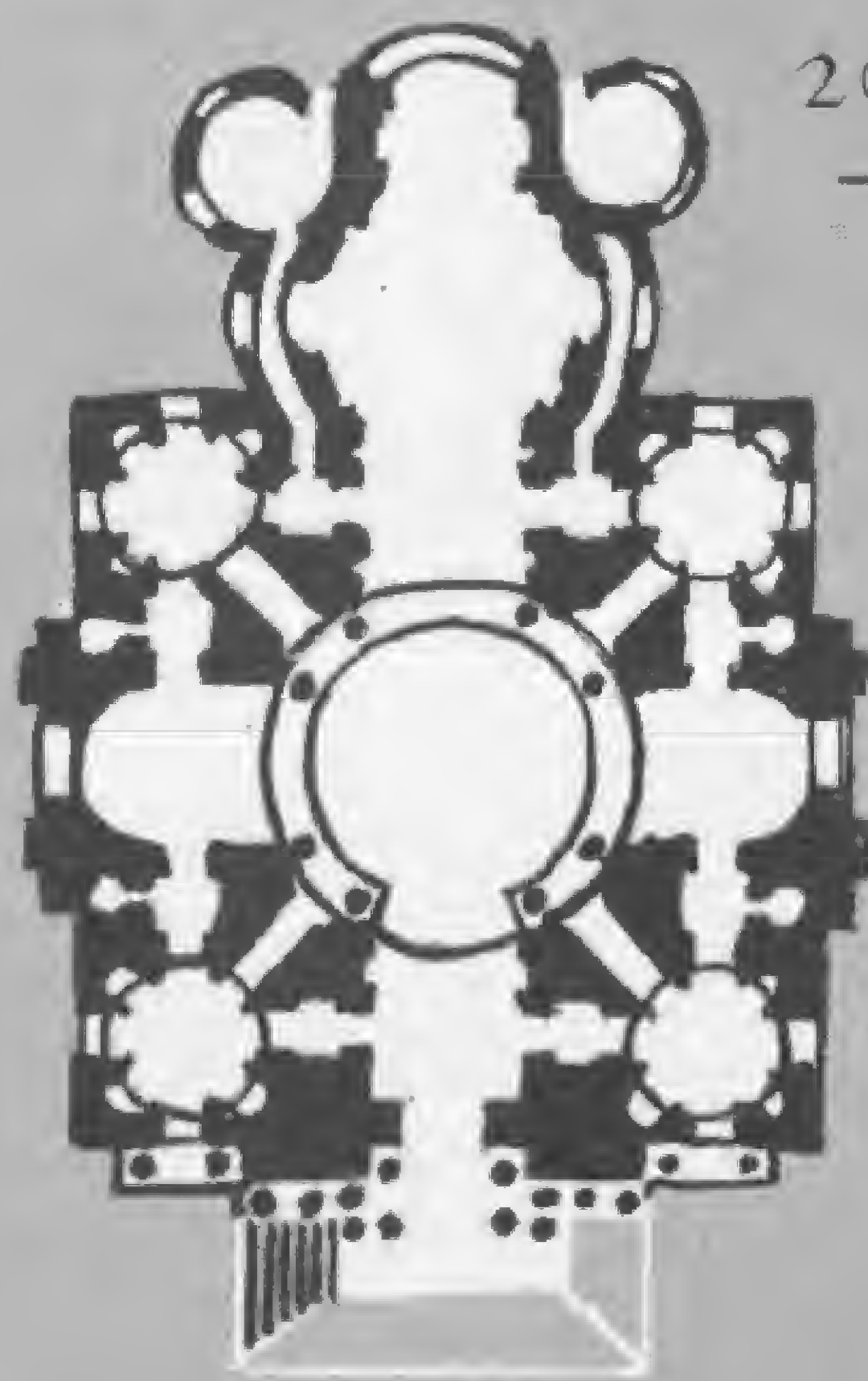


300

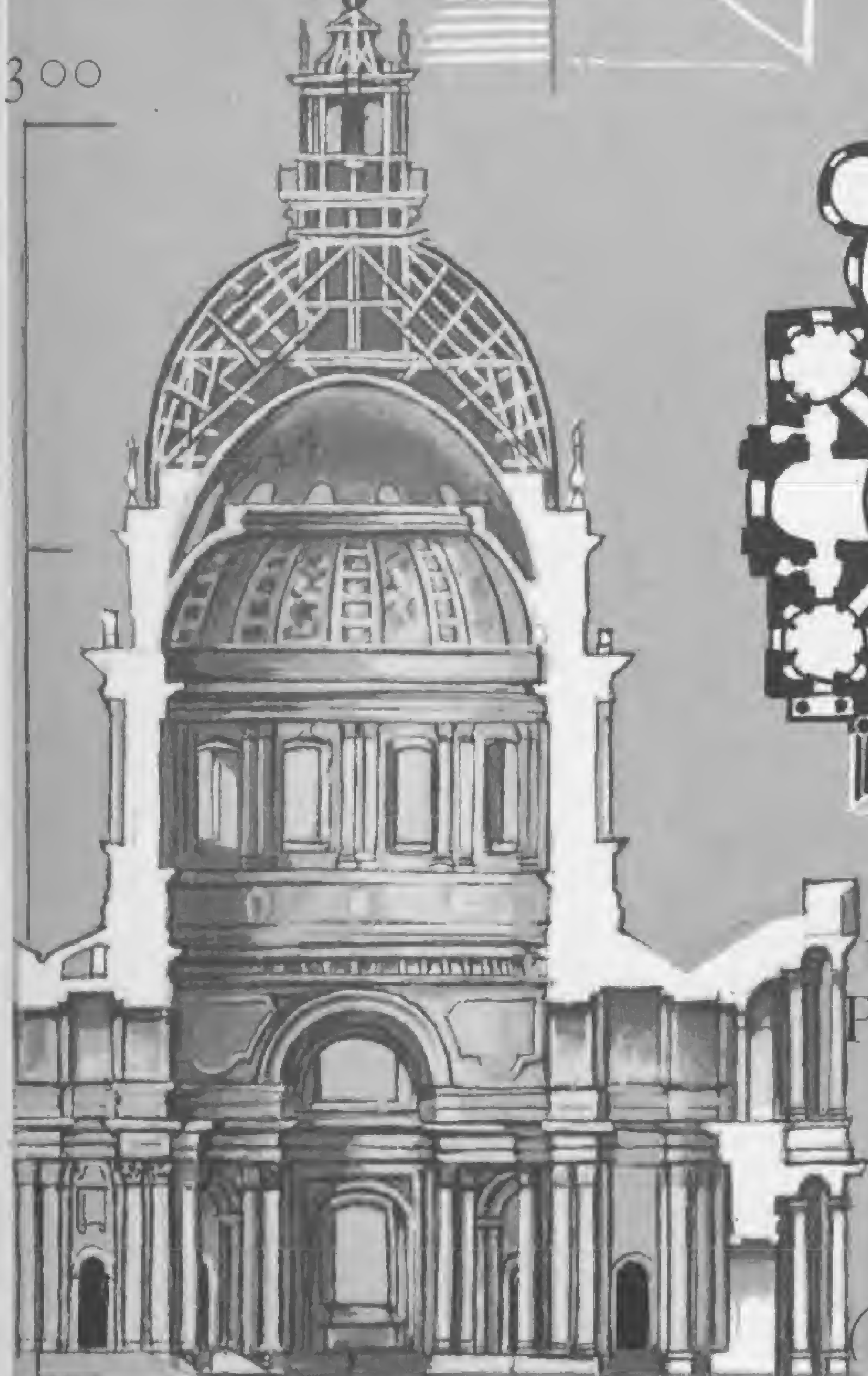
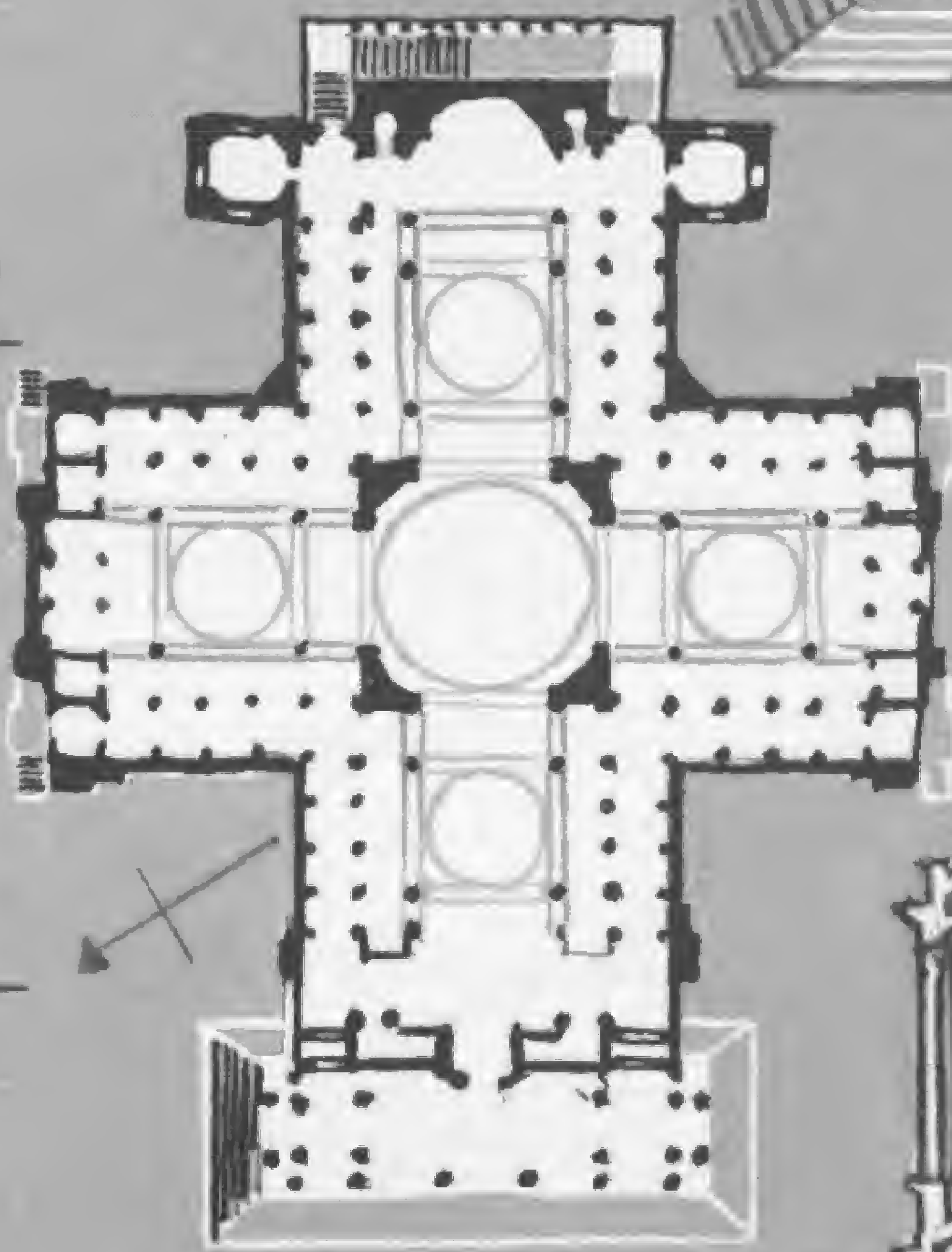
150

100

300

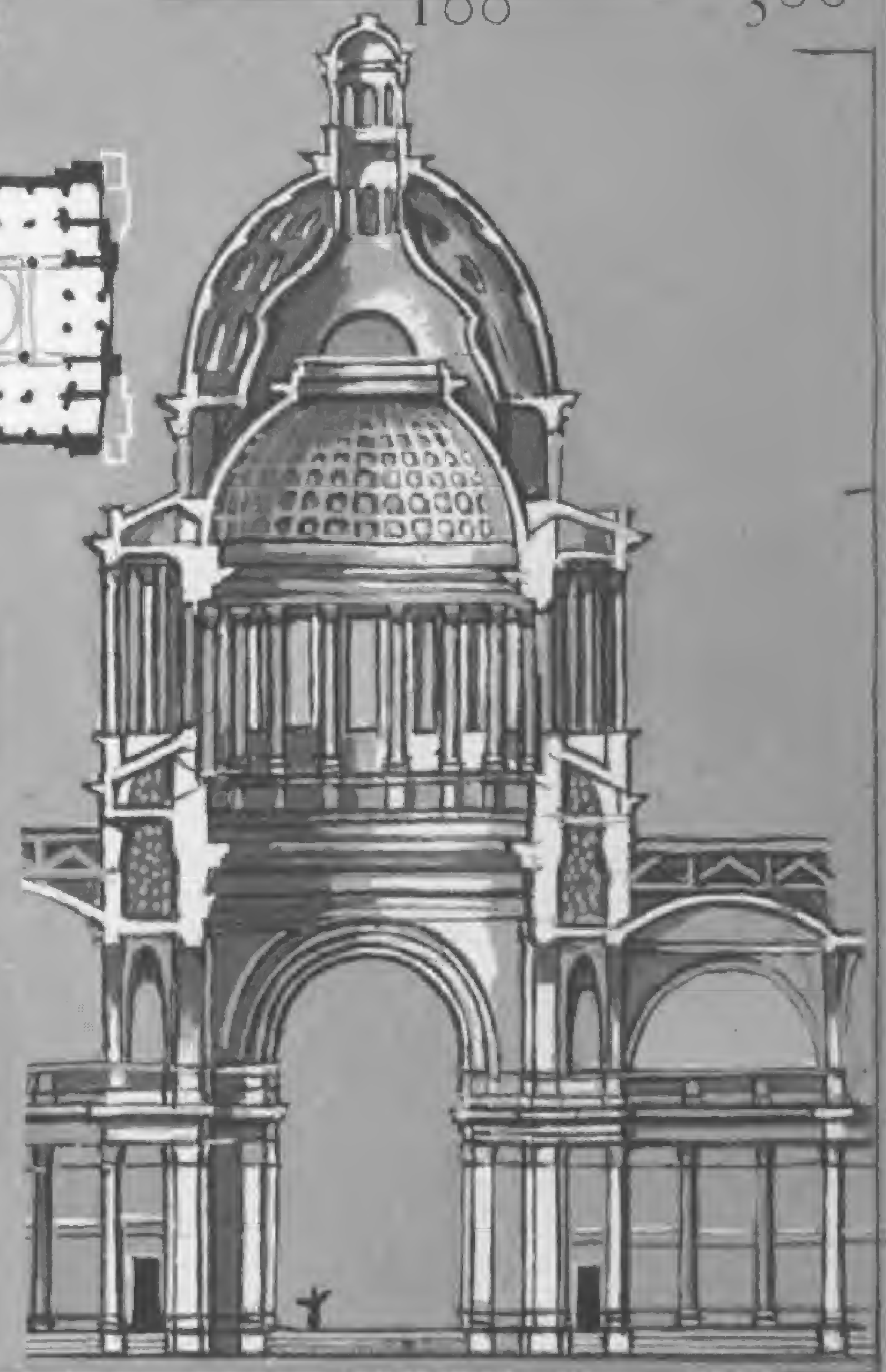


200

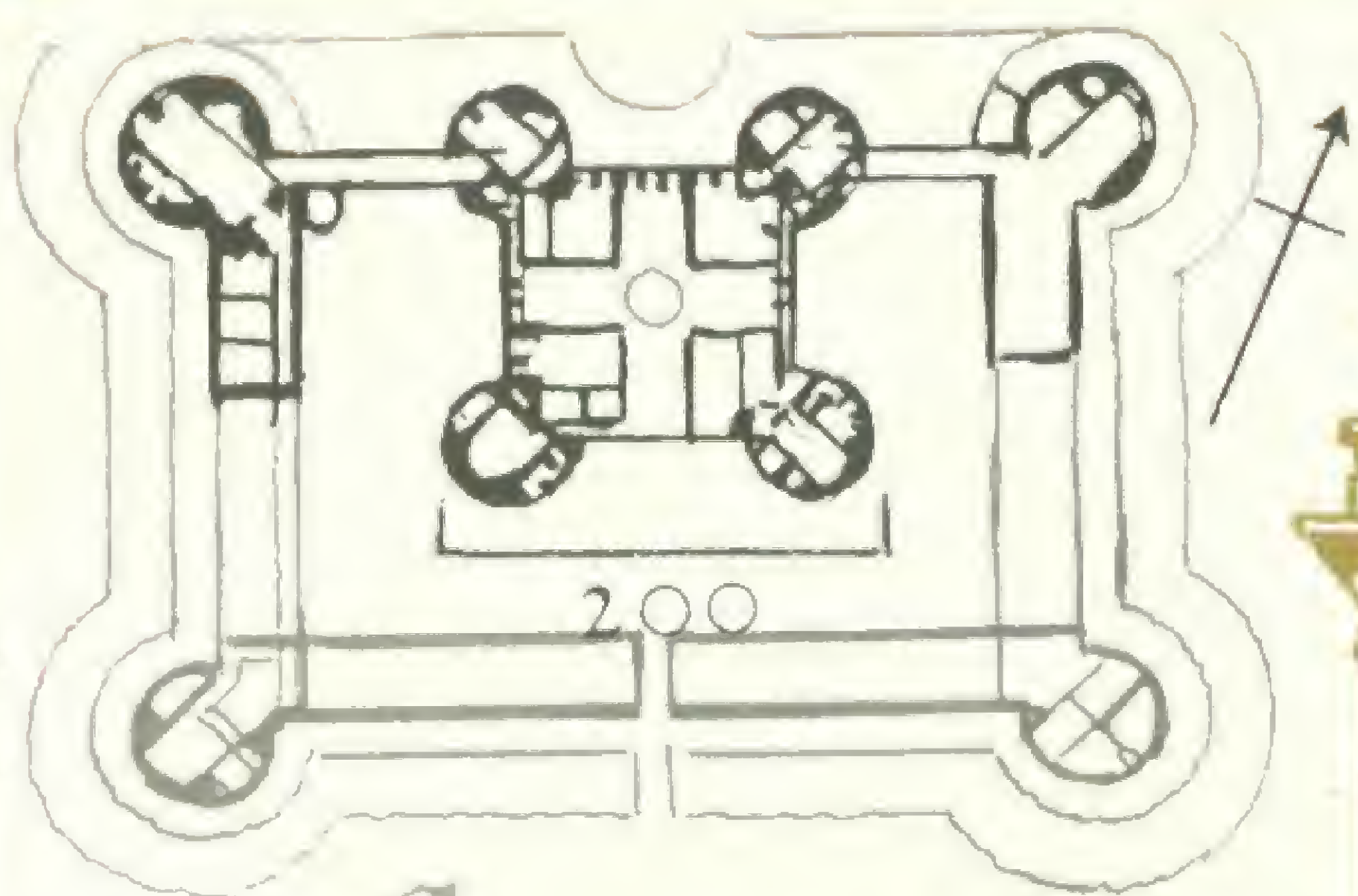


Church of
the Invalides,
Paris, 1680-91
*Jules
Hardouin
Mansart*
(1646-1708)

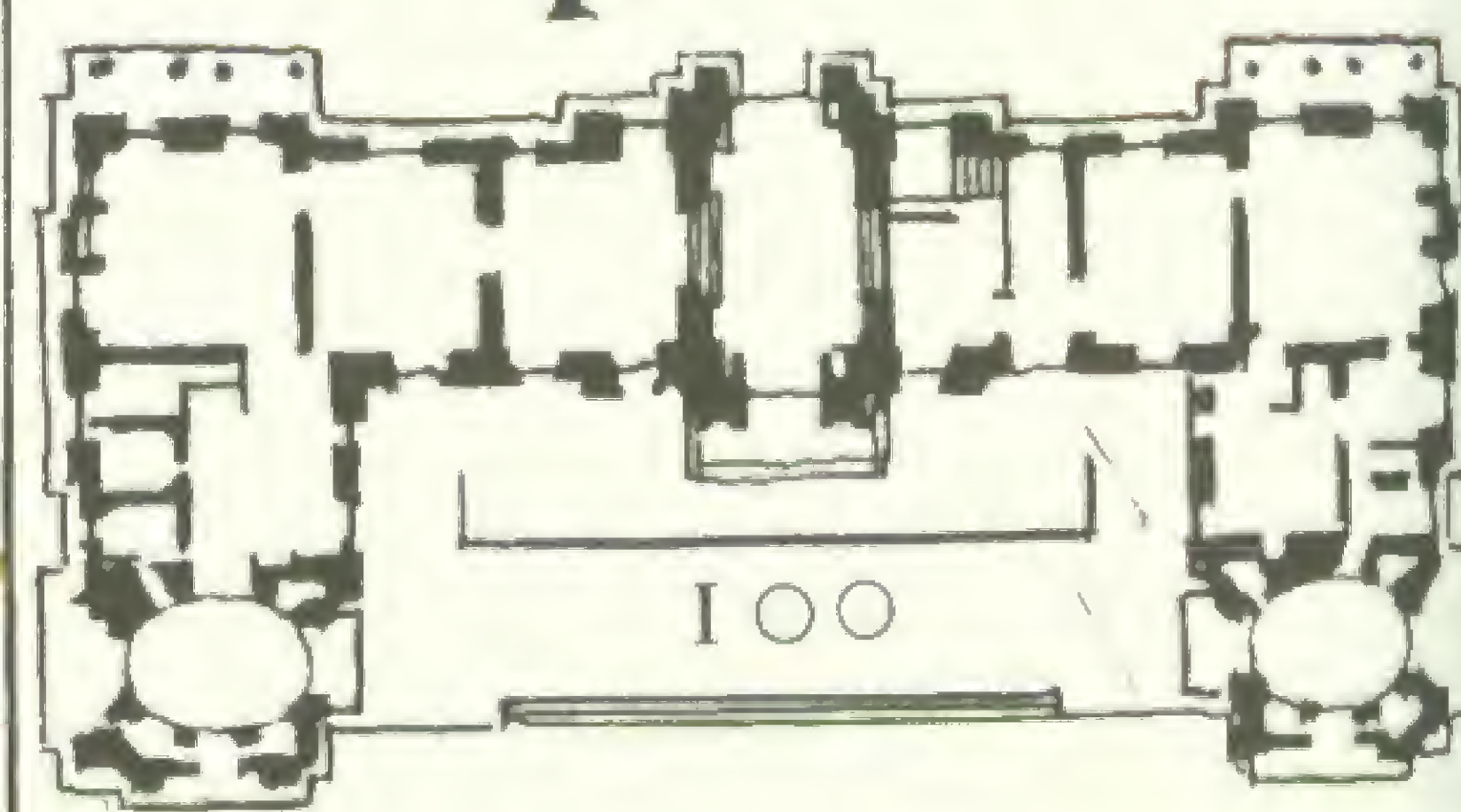
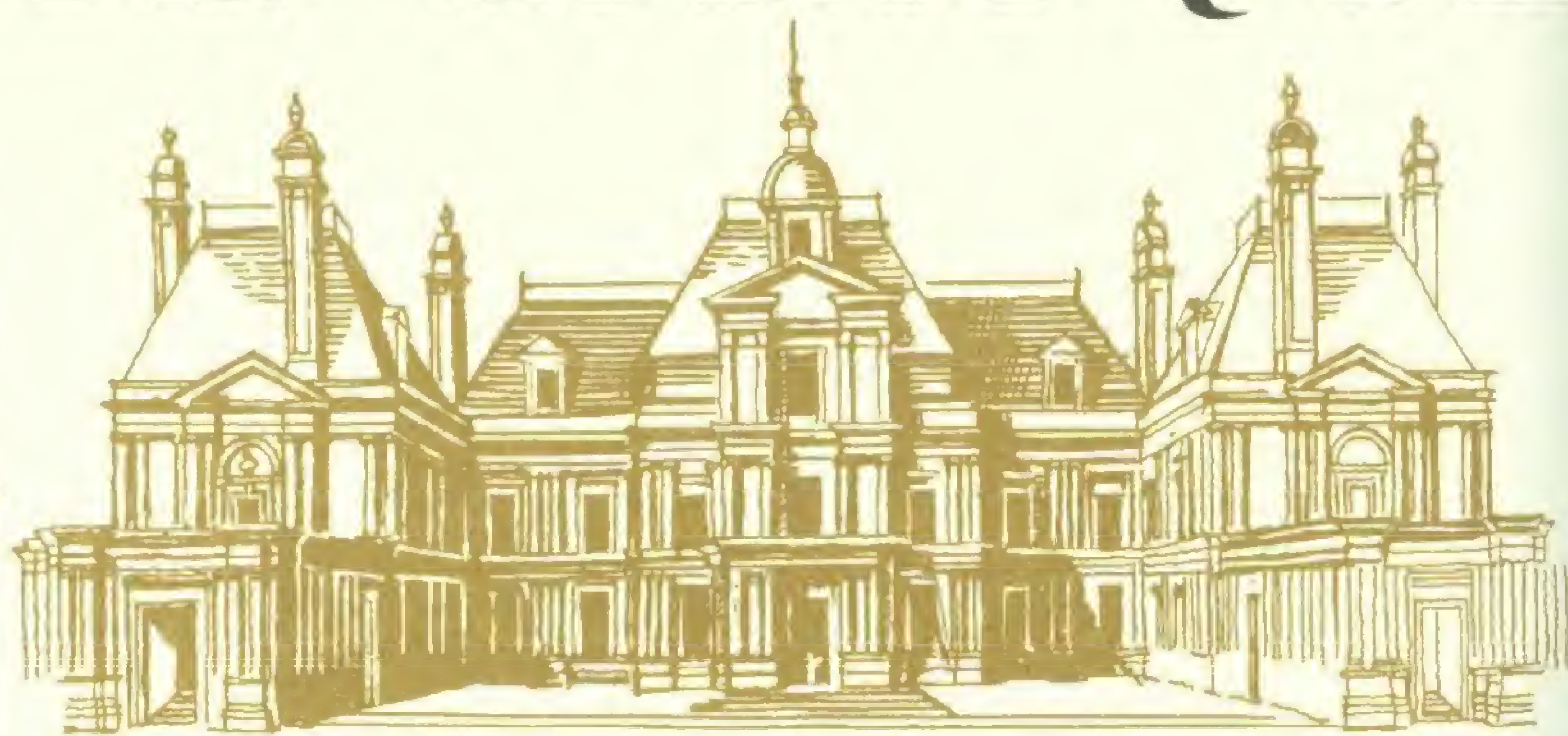
Panthéon
(St Génévieve),
Paris, 1764-90
*Jacques-
Germain
Soufflot*
(1713-80)



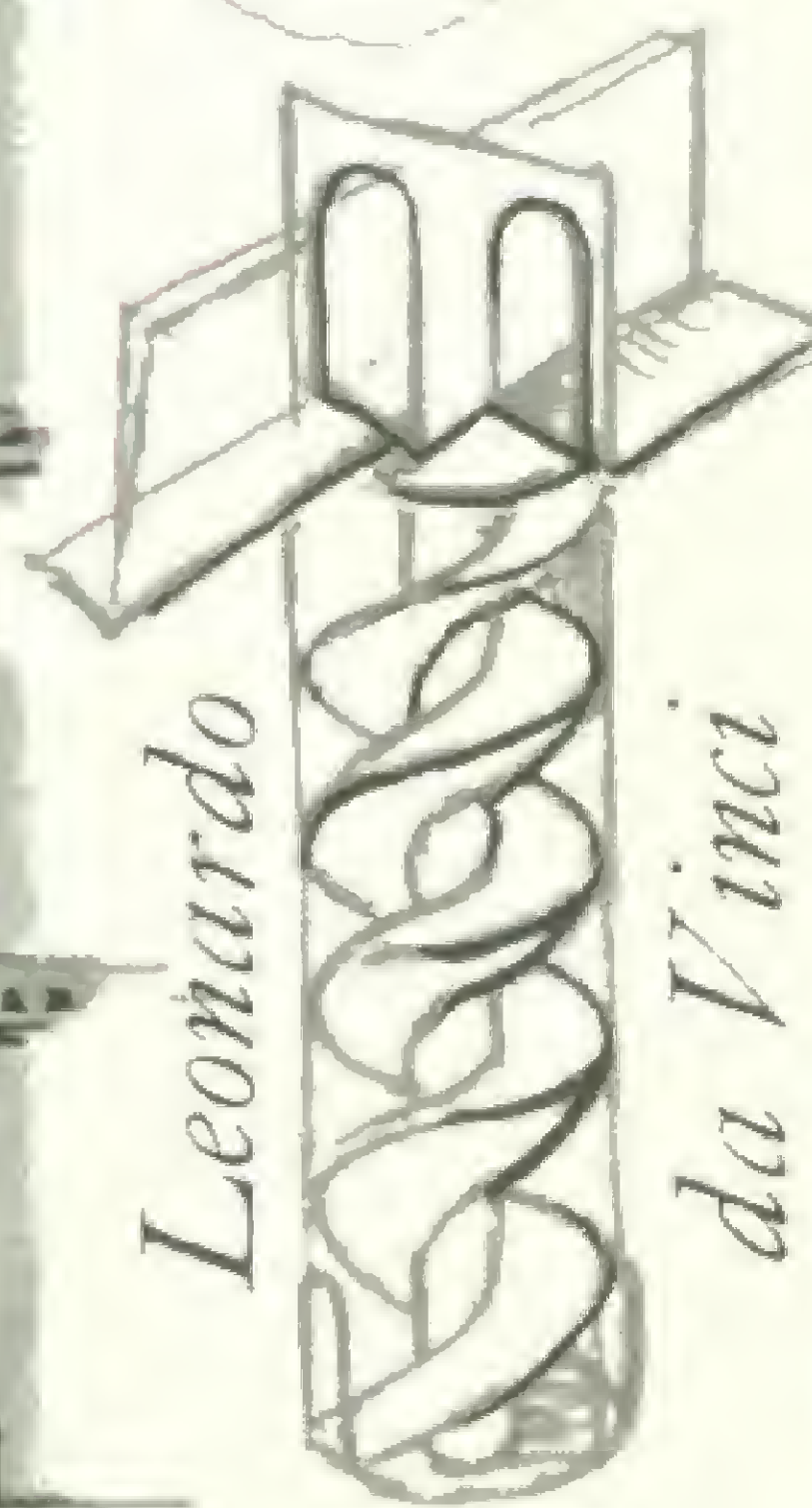
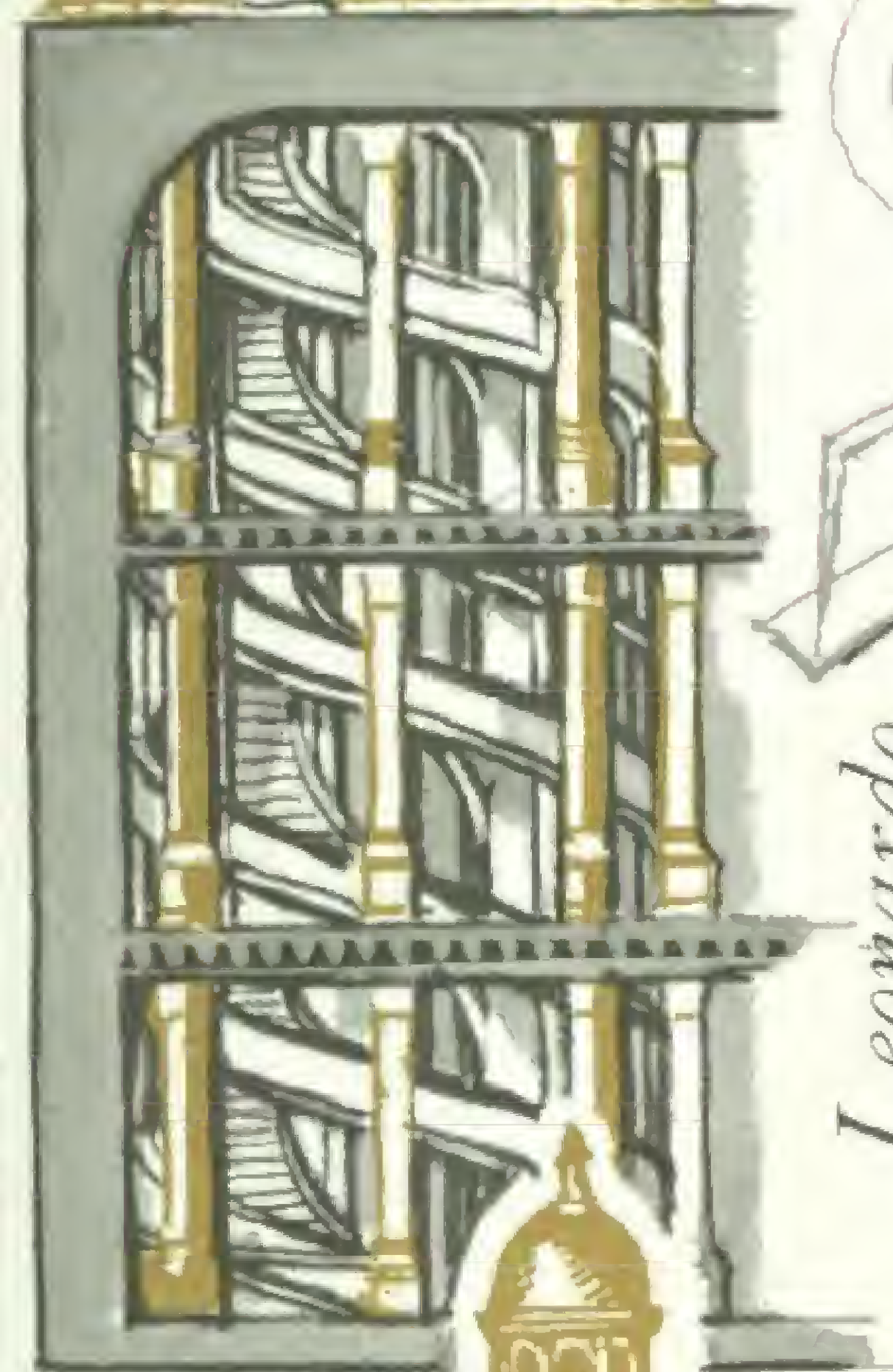
RENAISSANCE-BAROQUE



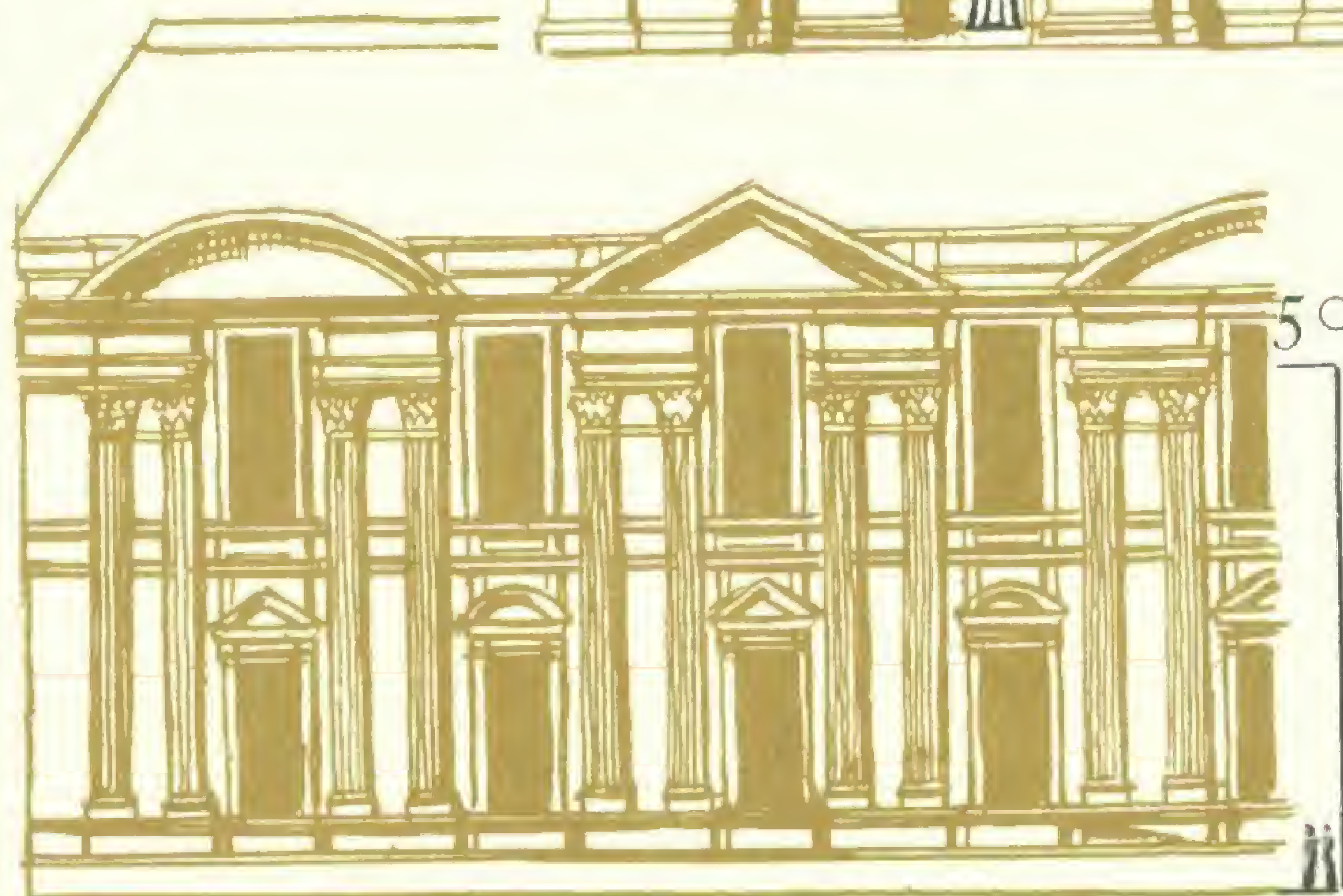
Château de Chambord,
1519-1547



Château de Maisons,
1642-46
François Mansart
(1598-1666)

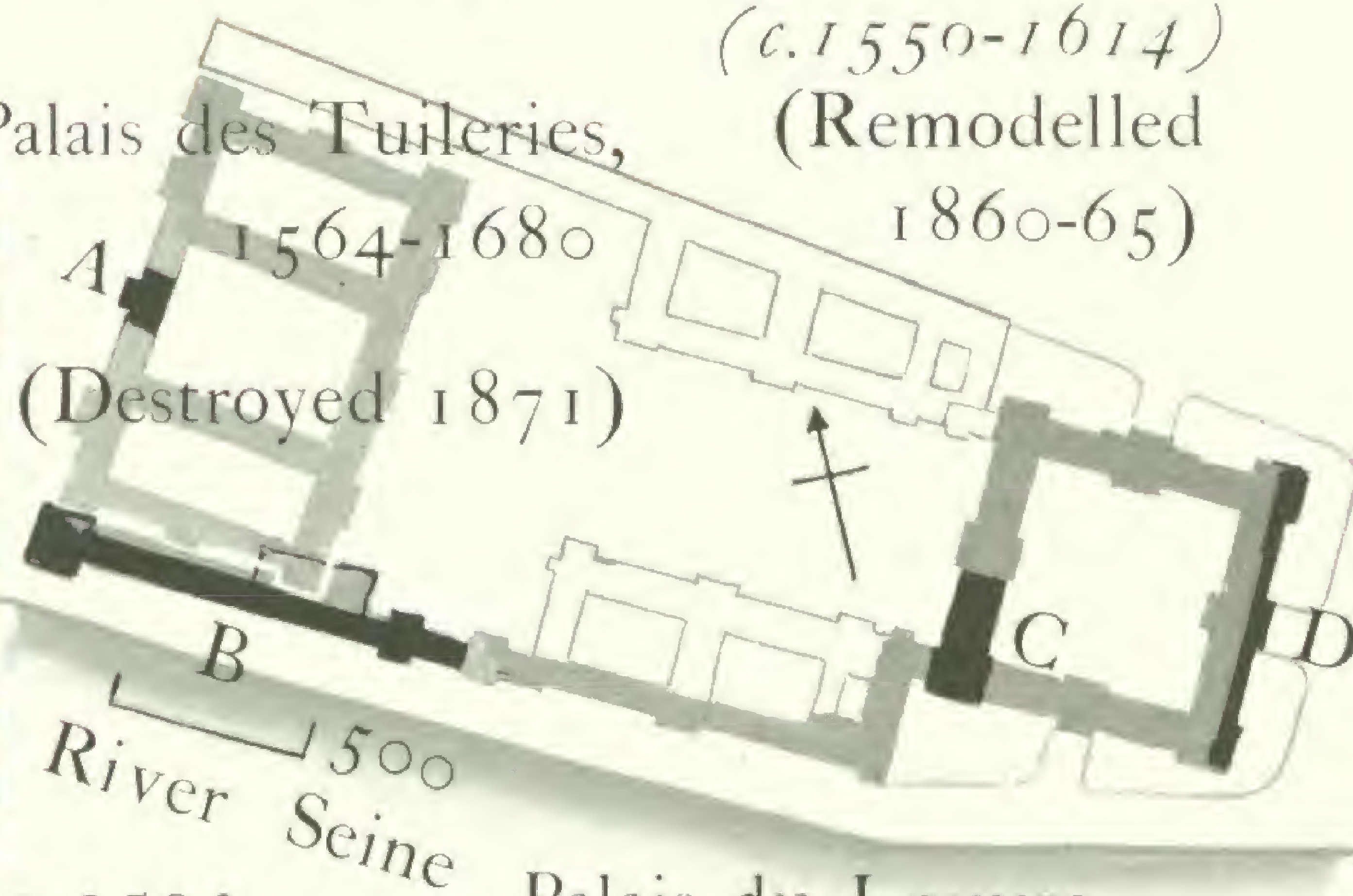


Leonardo da Vinci

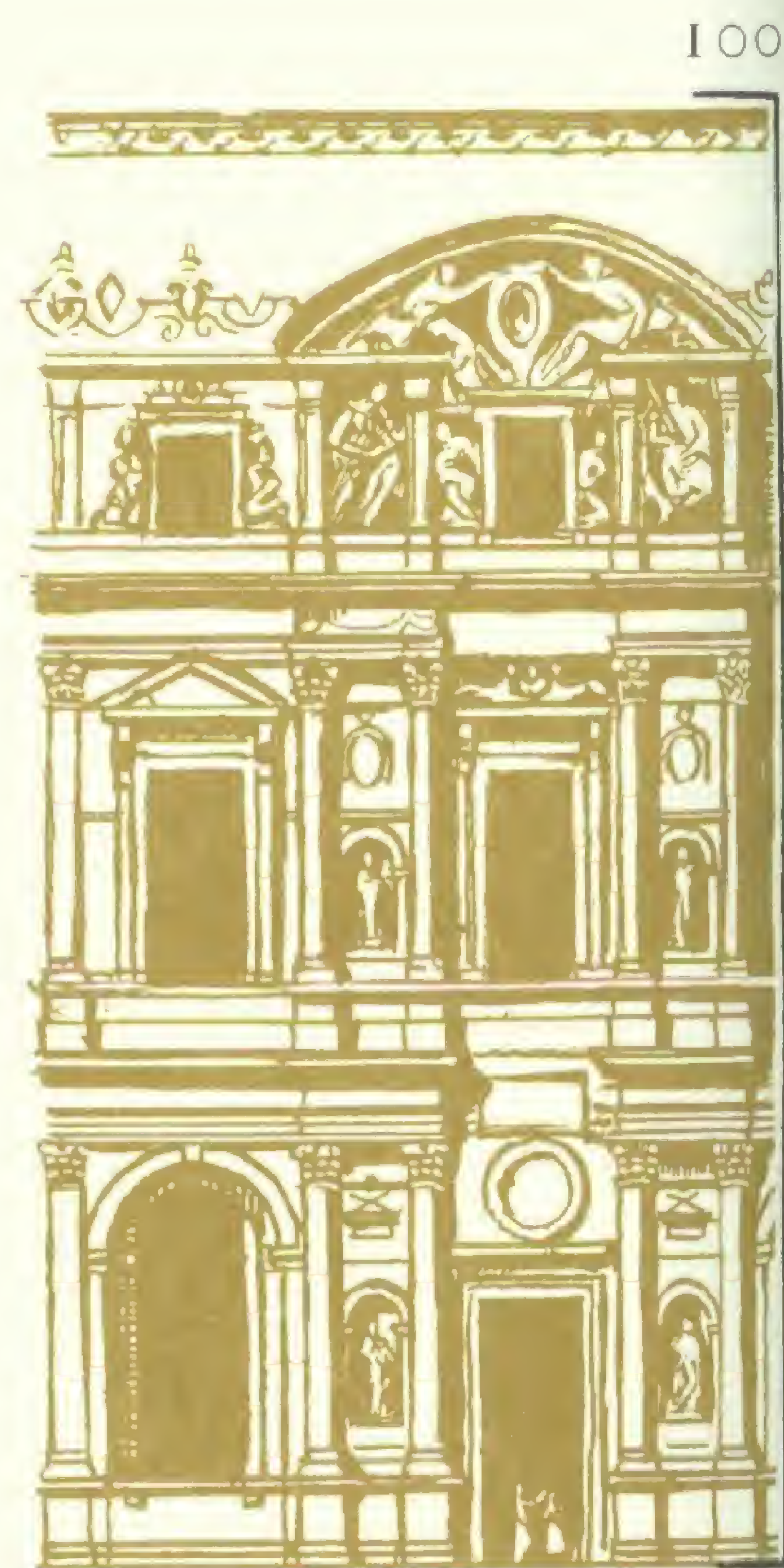


B. 1600-09 *Jacques du Cerceau*
(c.1550-1614)
(Remodelled 1860-65)

Palais des Tuileries,
A. 1564-1680
(Destroyed 1871)



Palais du Louvre,
Paris, 1546-1878

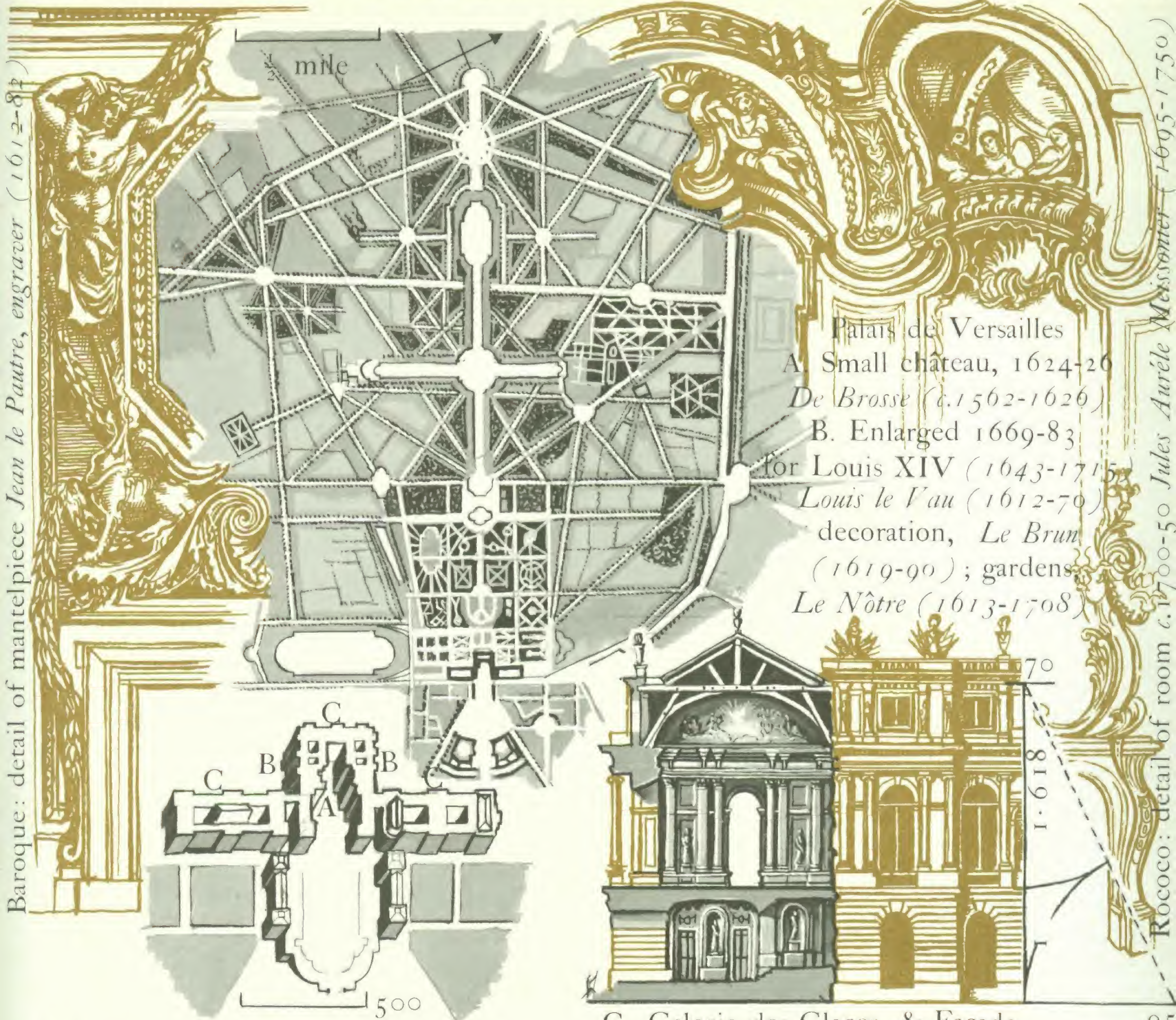


C. Course du Vieux
Louvre, begun 1546
Pierre Lescot (c.1510-78)



A. Central pavilion, 1570-1592
Philibert de l'Orme (c.1515-1570)

FRANCE, CHÂTEAU TO PALACE



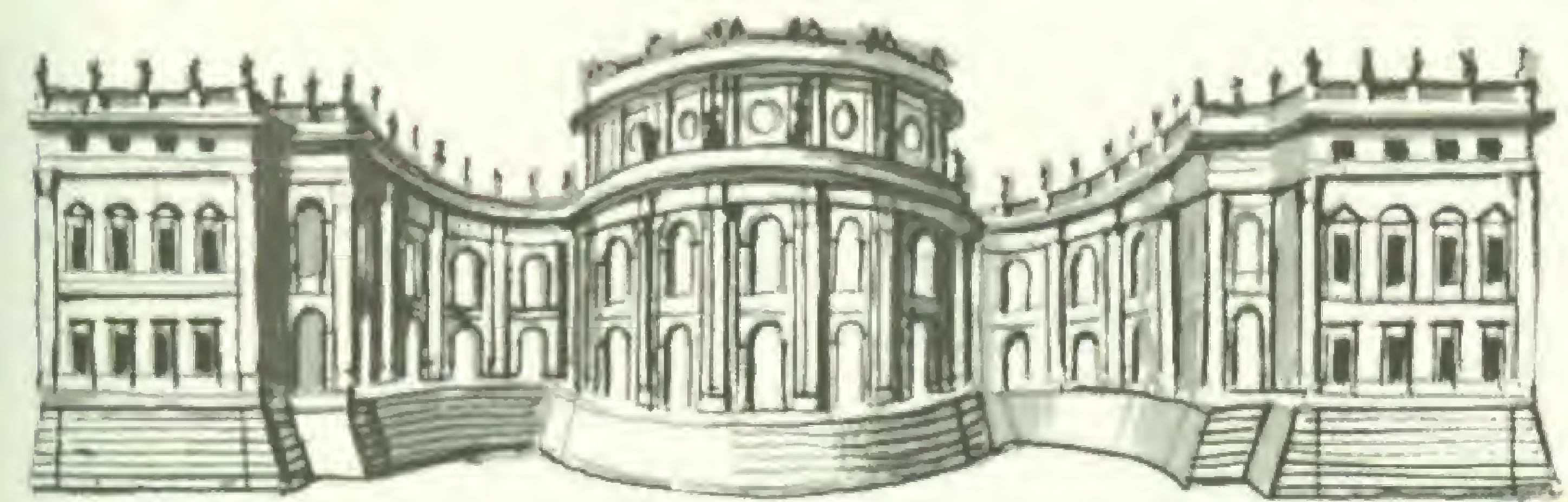
Baroque: detail of mantelpiece Jean le Pautre, engraver (1612-84)

Rococo: detail of room c.1700-50 Jules Aurèle Meissonnier (1695-1750)

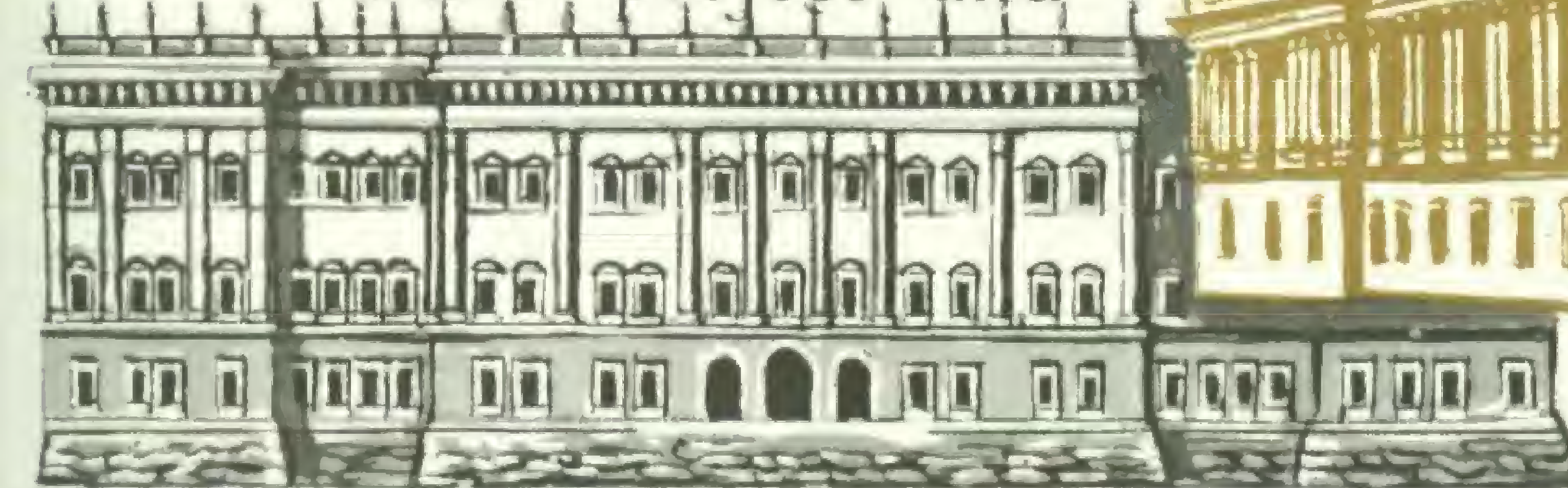
Palais de Versailles
A. Small château, 1624-26
De Brosse (c.1562-1626)
B. Enlarged 1669-83
for Louis XIV (1643-1715)
Louis le Vau (1612-70)
decoration, *Le Brun*
(1619-90); gardens
Le Nôtre (1613-1708)

C. Galerie des Glaces, & Façade
1679-82 *J. H. Mansart*
(1646-1708)

95



First project and



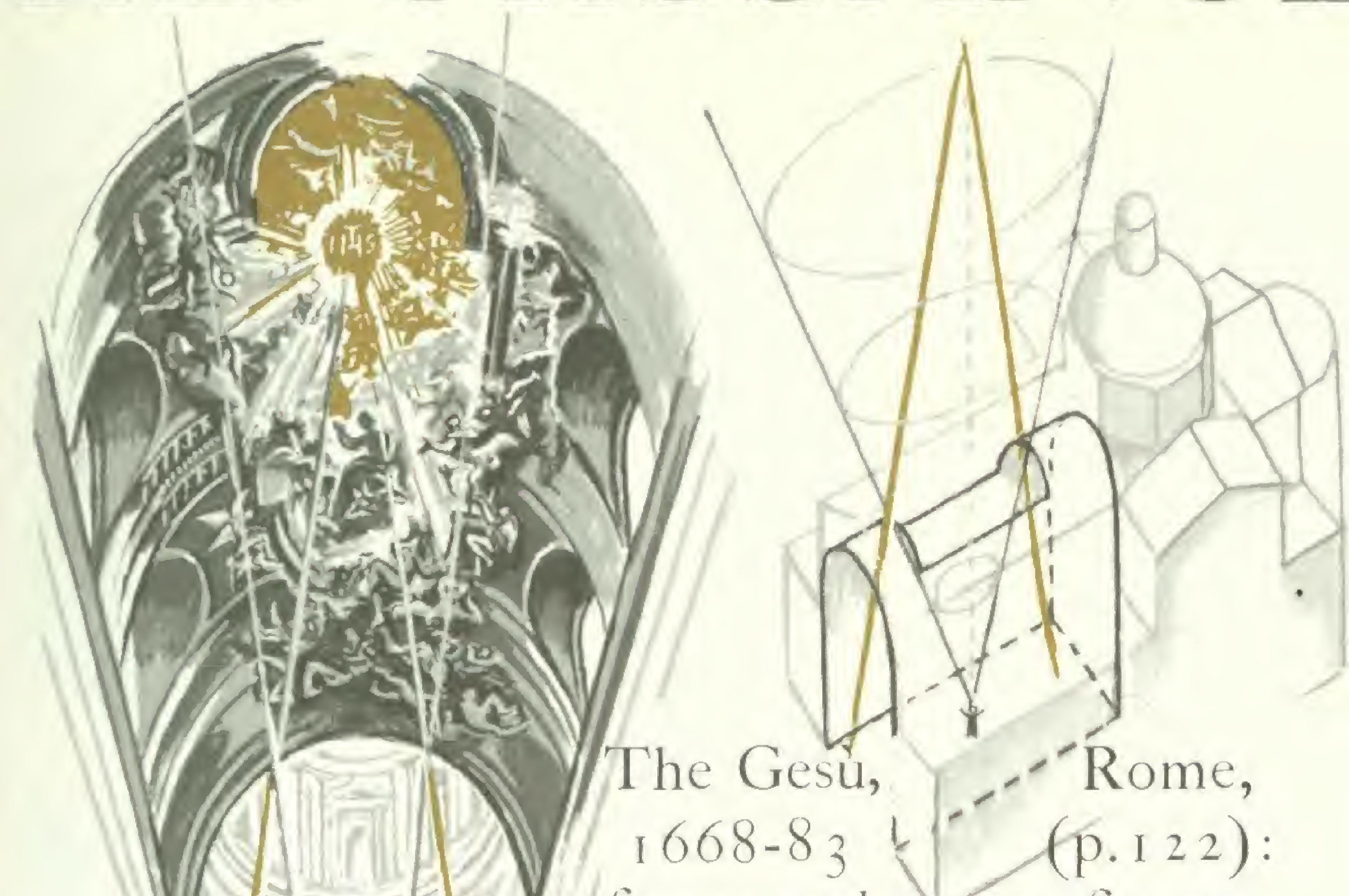
final project made by *Bernini* (1598-1680)
in Paris, 1665 for the East Front of the Louvre

D. East front, 1667-70

Claude Perrault (1613-88),
Louis Le Vau (1612-88) &
Charles Le Brun (1619-90)

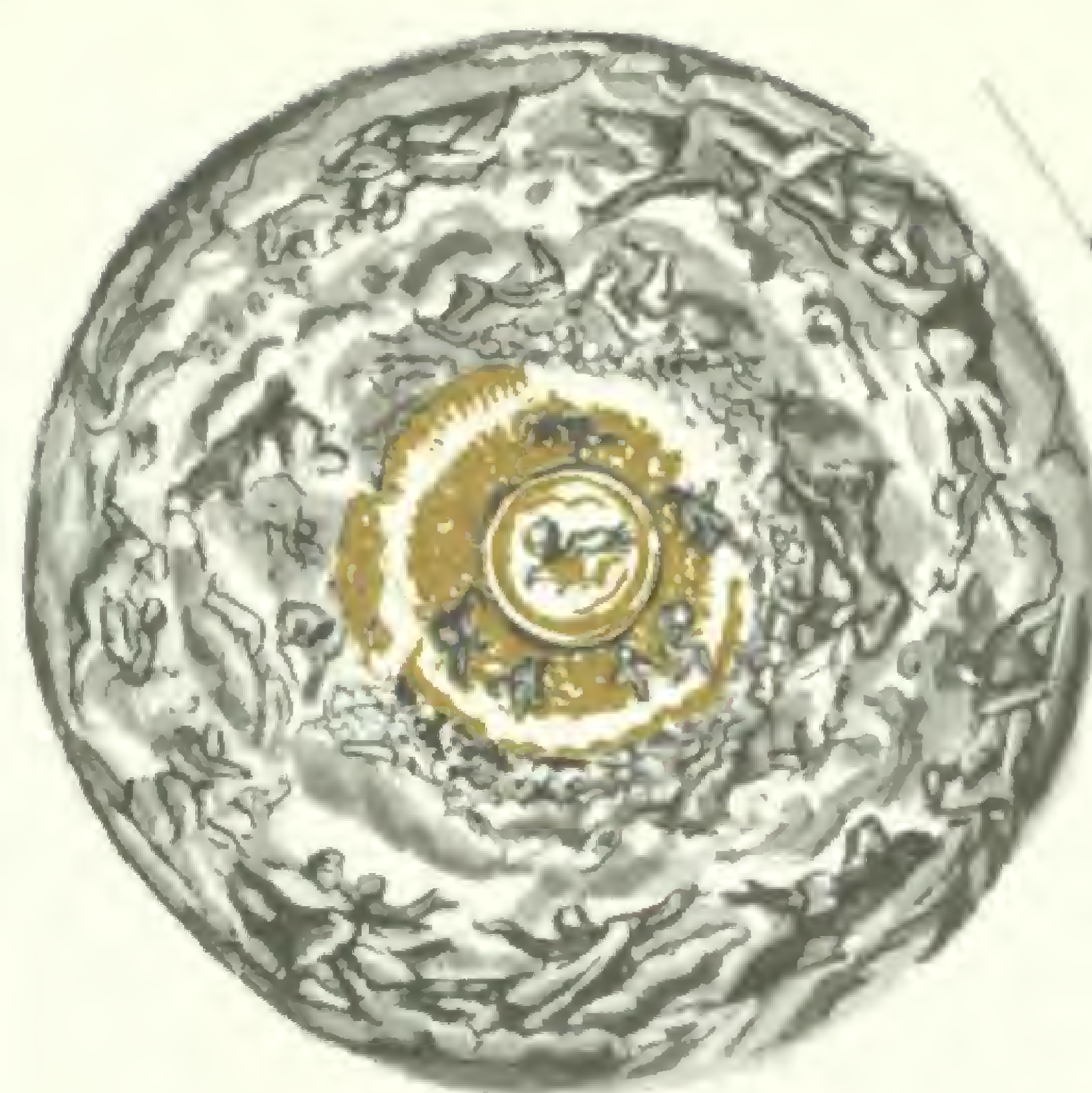
1.618

RENAISSANCE-BAROQUE



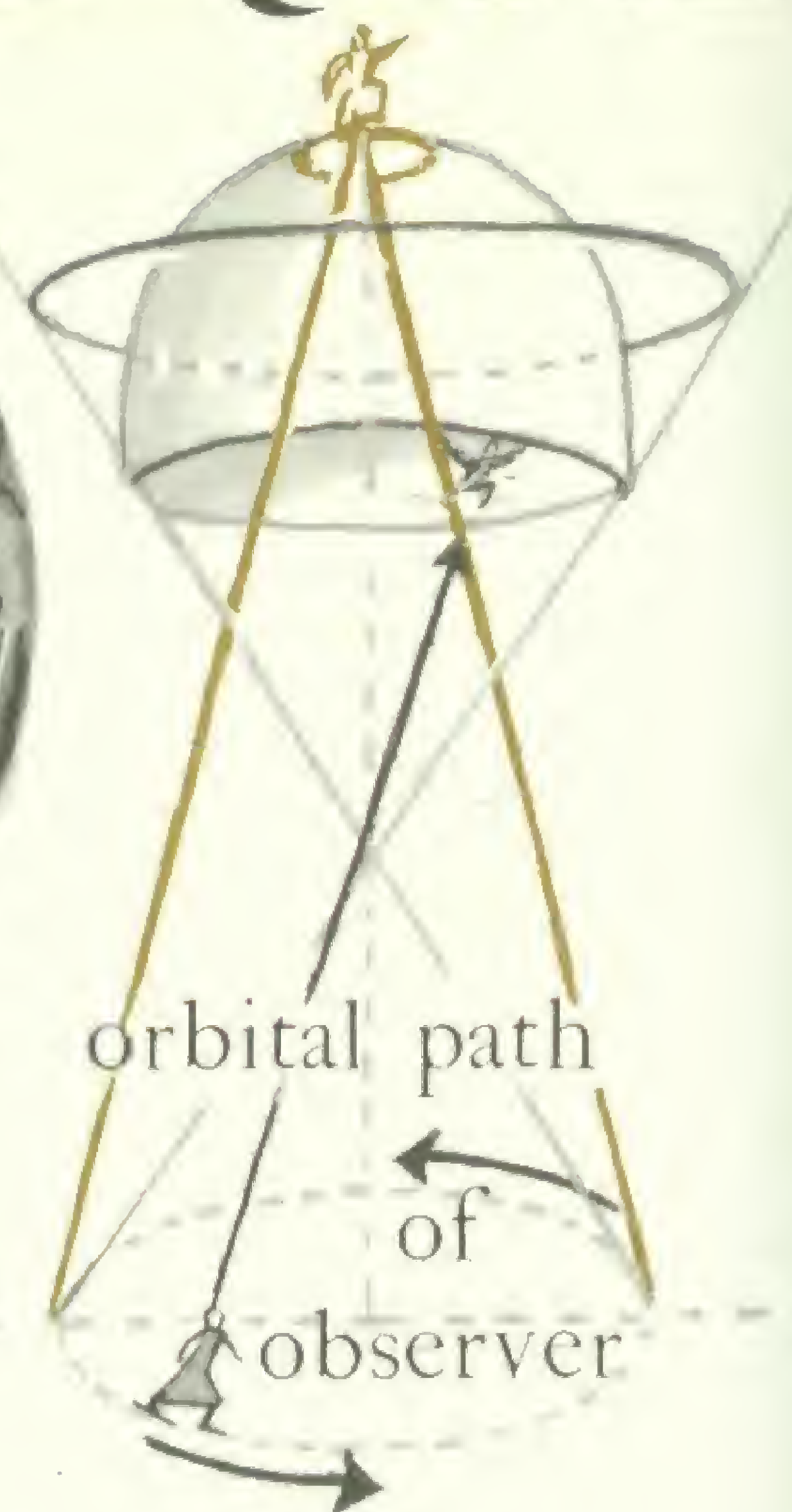
The Gesù, Rome, 1668-83 (p.122): fresco and stucco figures on nave vault, 1674-79,

'Adoration of the Name of Jesus'
Giovanni Battista Gaulli (1639-1709)



S. Andrea in Valle, Rome, 1591-1623: fresco in dome, 'The Virgin in Glory'

Giovanni Lanfranco (1582-1647)

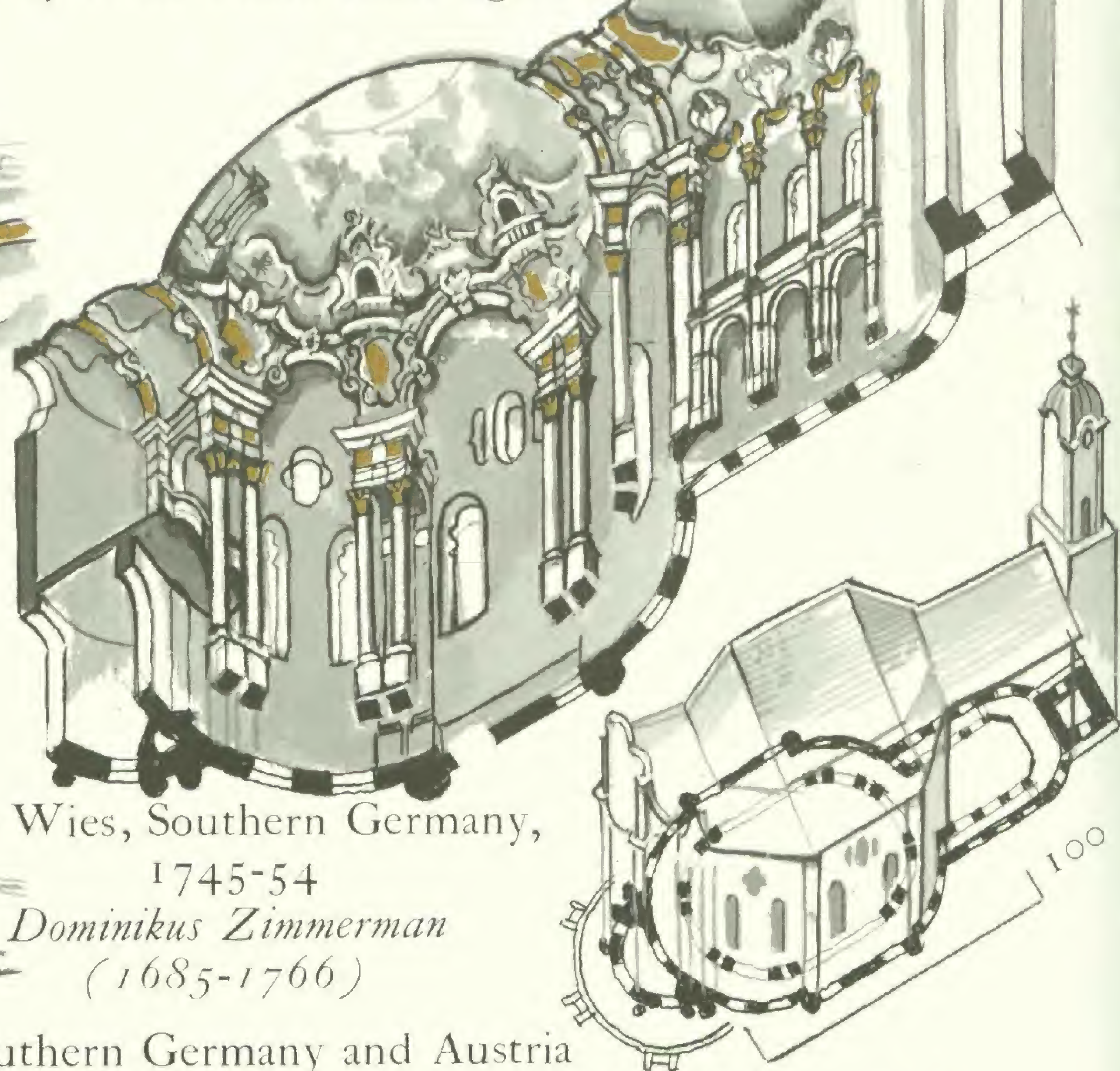


Italian Baroque churches

Vaults, domes and apses were frequently 'opened out' to heaven by means of *sotto in su* (Italian: 'from below upwards'), illusionist paintings, and often reinforced by three-dimensional figures



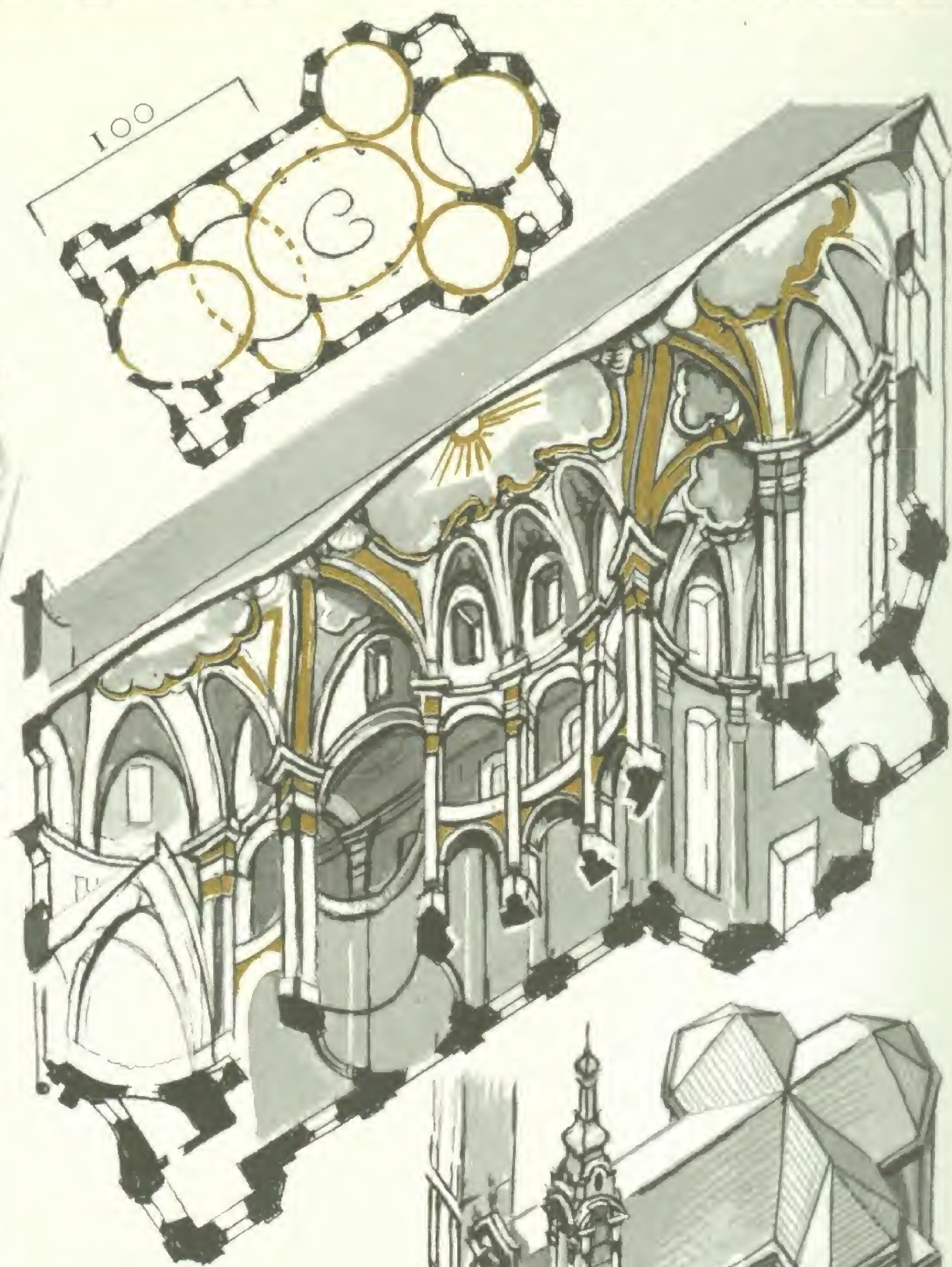
Die Wies, Southern Germany, 1745-54
Dominikus Zimmermann (1685-1766)



In Southern Germany and Austria many Jesuit Baroque churches were built in the style of the Gesù (p.122).

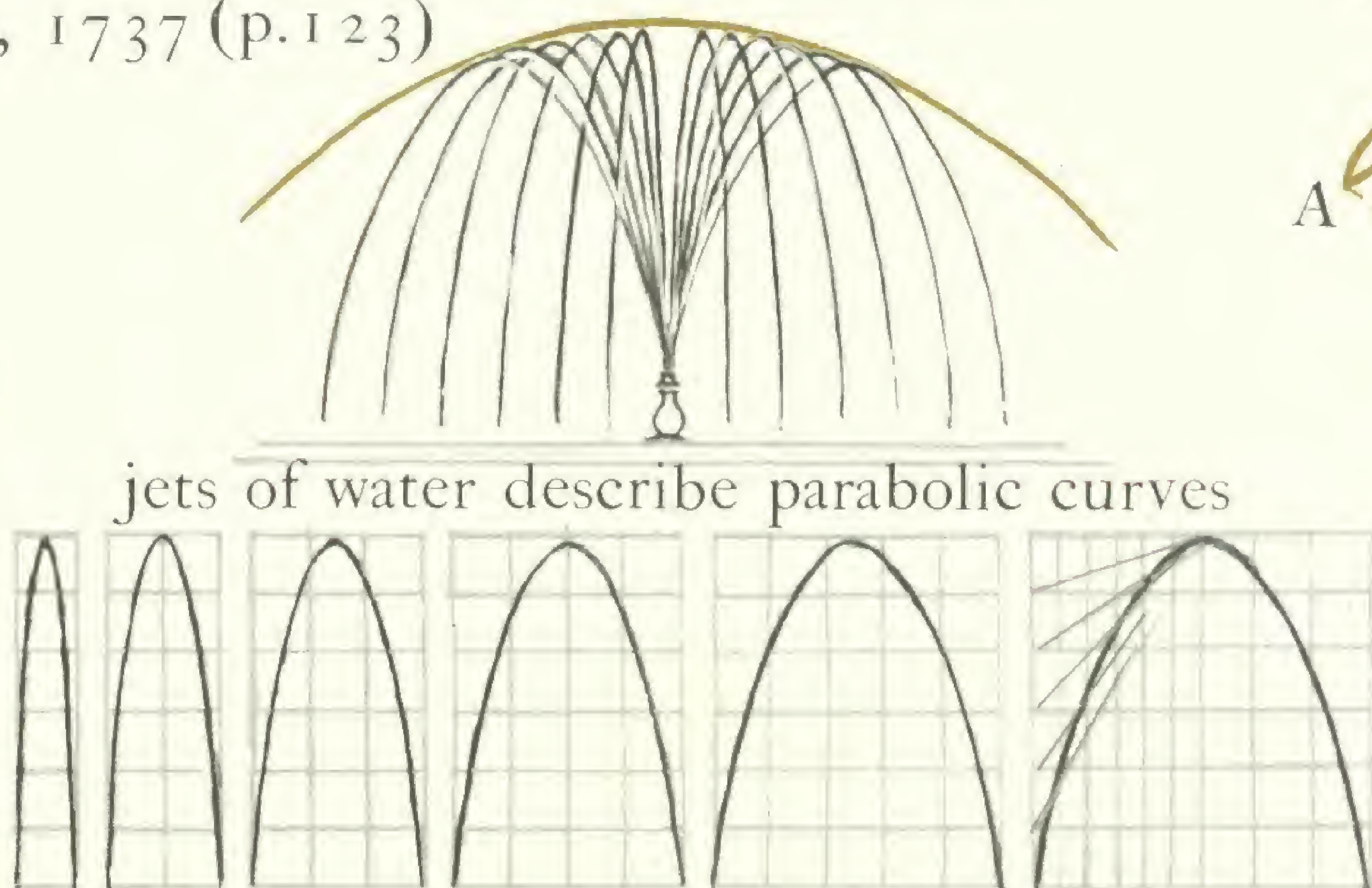
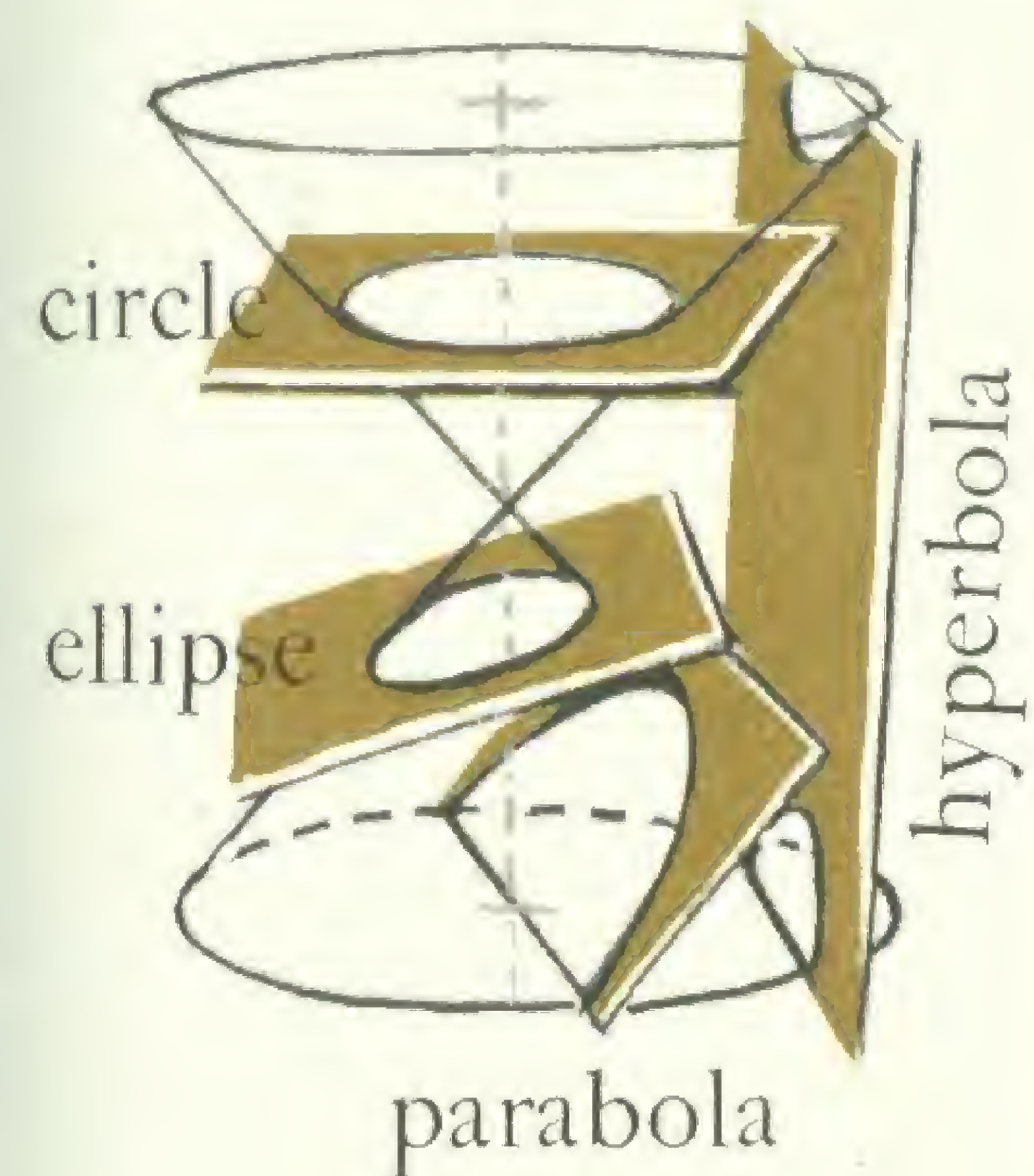
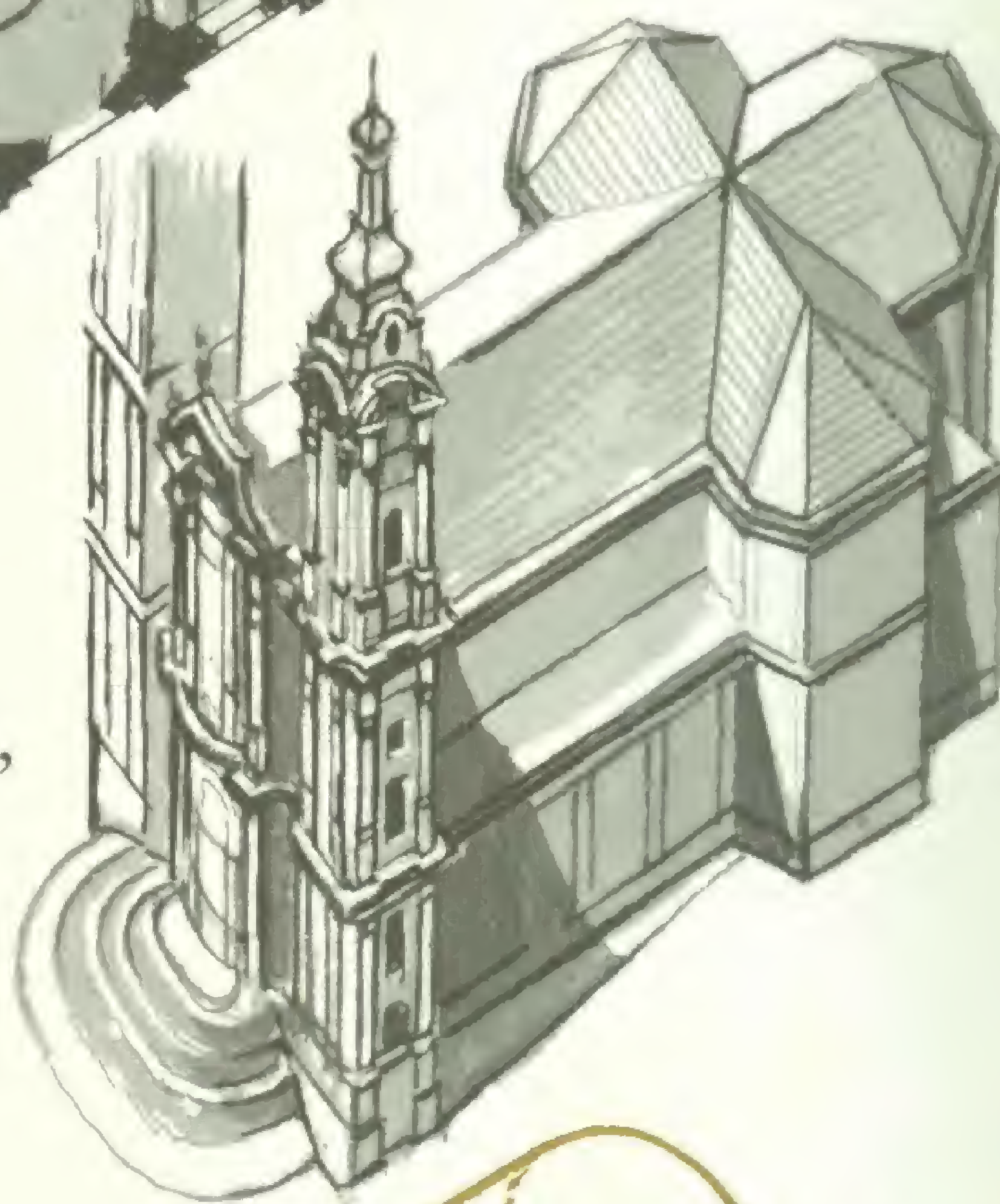
The 'Thirty Years' War (1618-48) was followed by a resurgence of church-building in which all the arts—architecture, sculpture, painting and music—were fused into Rococo.

GERMANY, ROCOCO CHURCHES

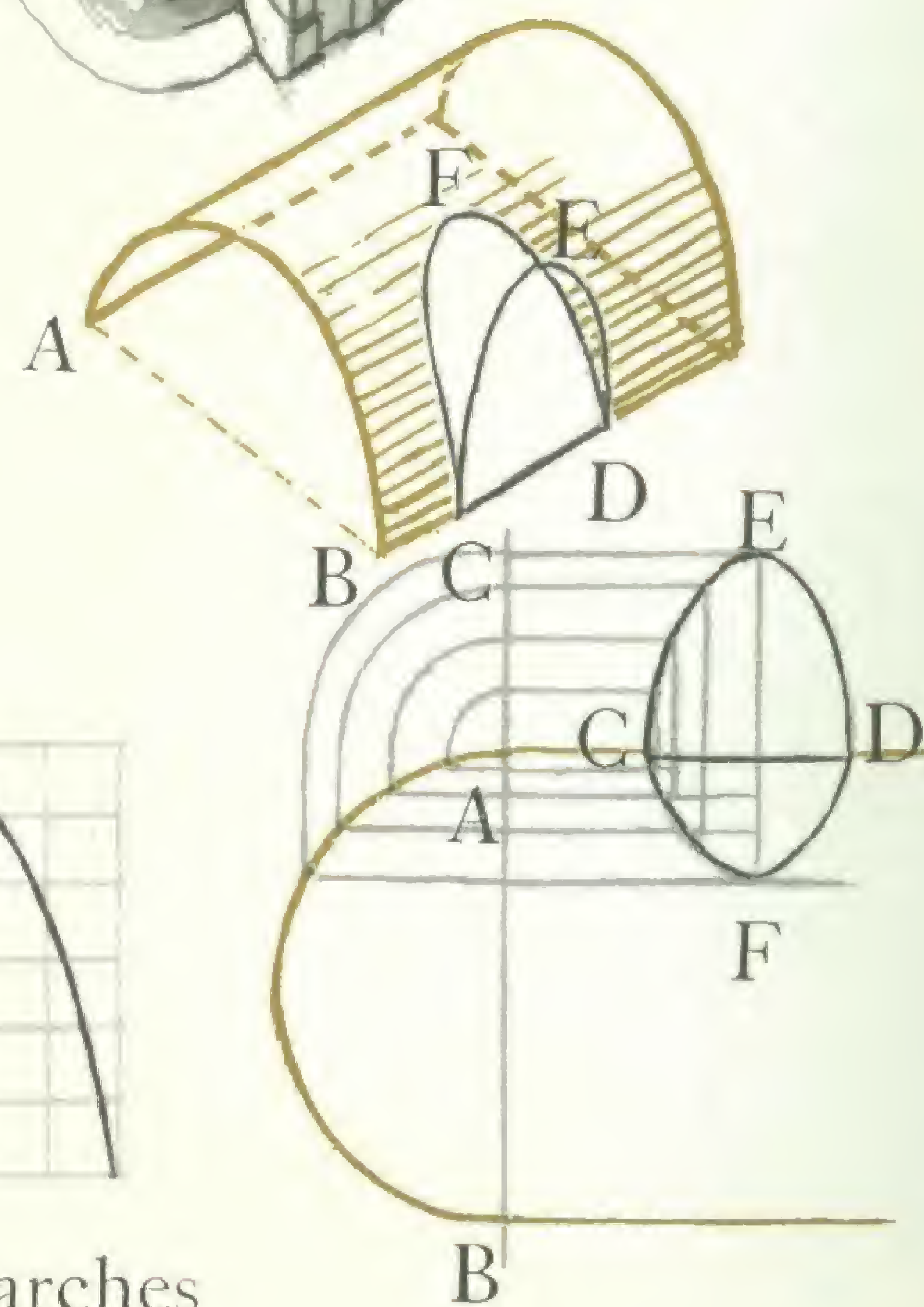


Vierzehnheiligen, Southern Germany,
1744-72

Balthasar Neumann (1687-1753),
architect, mathematician, military engineer, town-planner,
designer of fountains, bell-caster; possessed Guarini's
dell' Architettura Civile, 1737 (p.123)

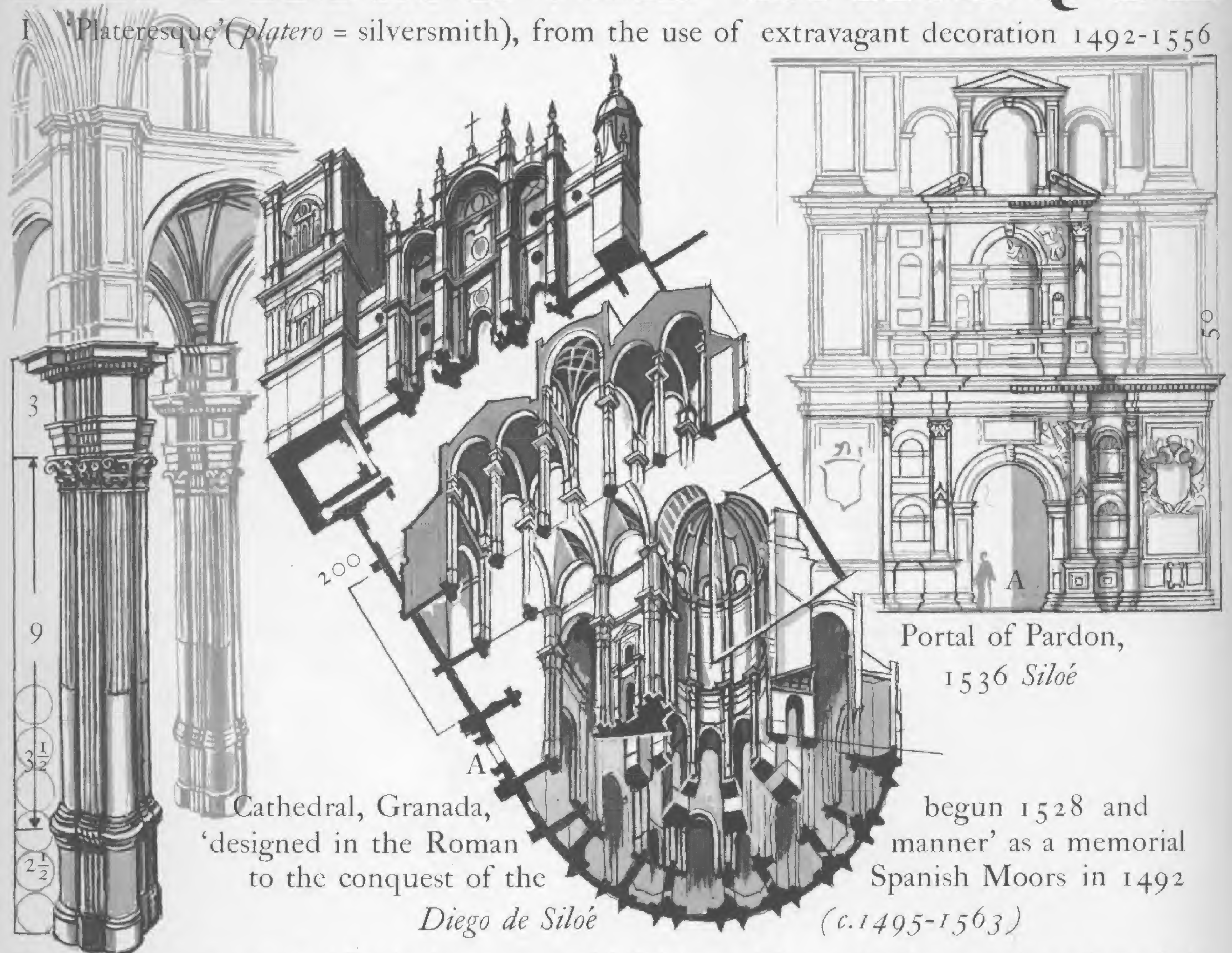


parabolic, forward tilted, three-dimensional arches

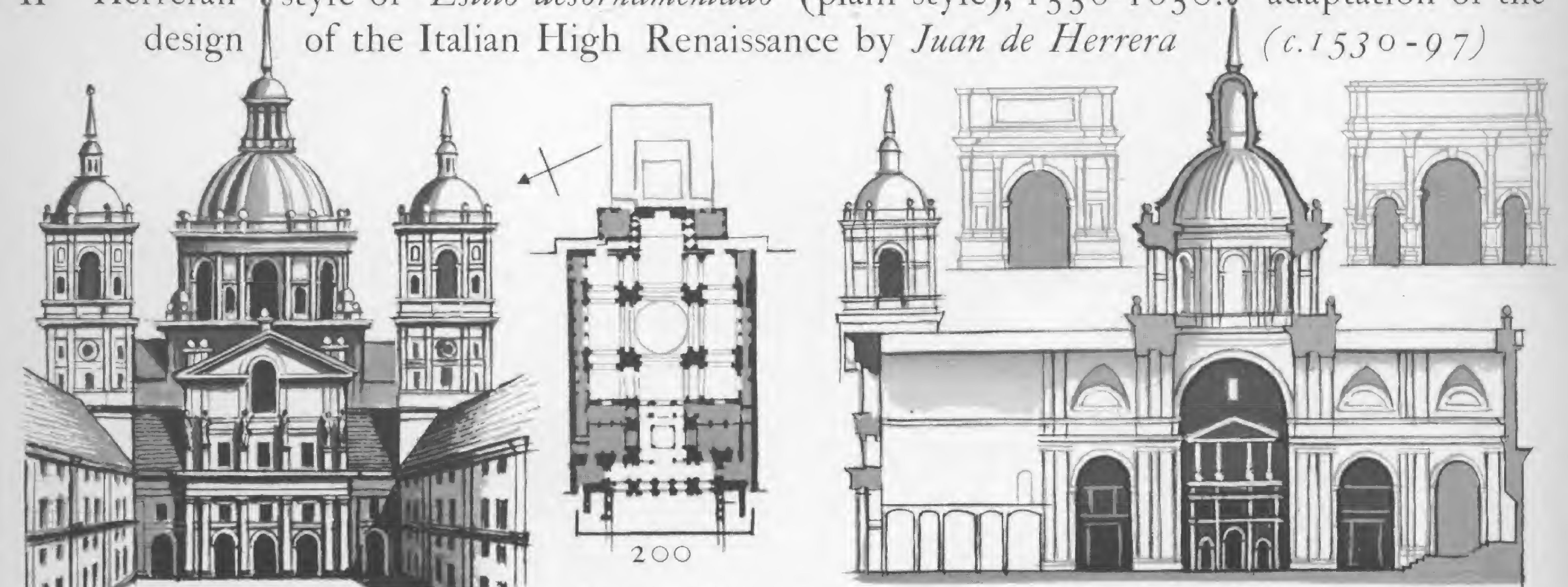


RENAISSANCE-BAROQUE

I 'Plateresque' (*platero* = silversmith), from the use of extravagant decoration 1492-1556



II Herreran style or '*Estilo desornamentado*' (plain style), 1556-1650: adaptation of the design of the Italian High Renaissance by *Juan de Herrera* (c.1530-97)



The Escorial 1574-82 (p.115), Doric Church, first designed by Juan Bautista de Toledo (d.1567), philosopher and mathematician, who worked under Michelangelo; redesigned by *Juan de Herrera* (c.1530-97) built in yellow-grey granite, in 2:3 ratios

III 'Churrigueresque', named after *José de Churriguera* (1665-1723)

Cathedral,
Santiago
de Compostella:
west façade,
known as
'El Obradoiro',
c.1738

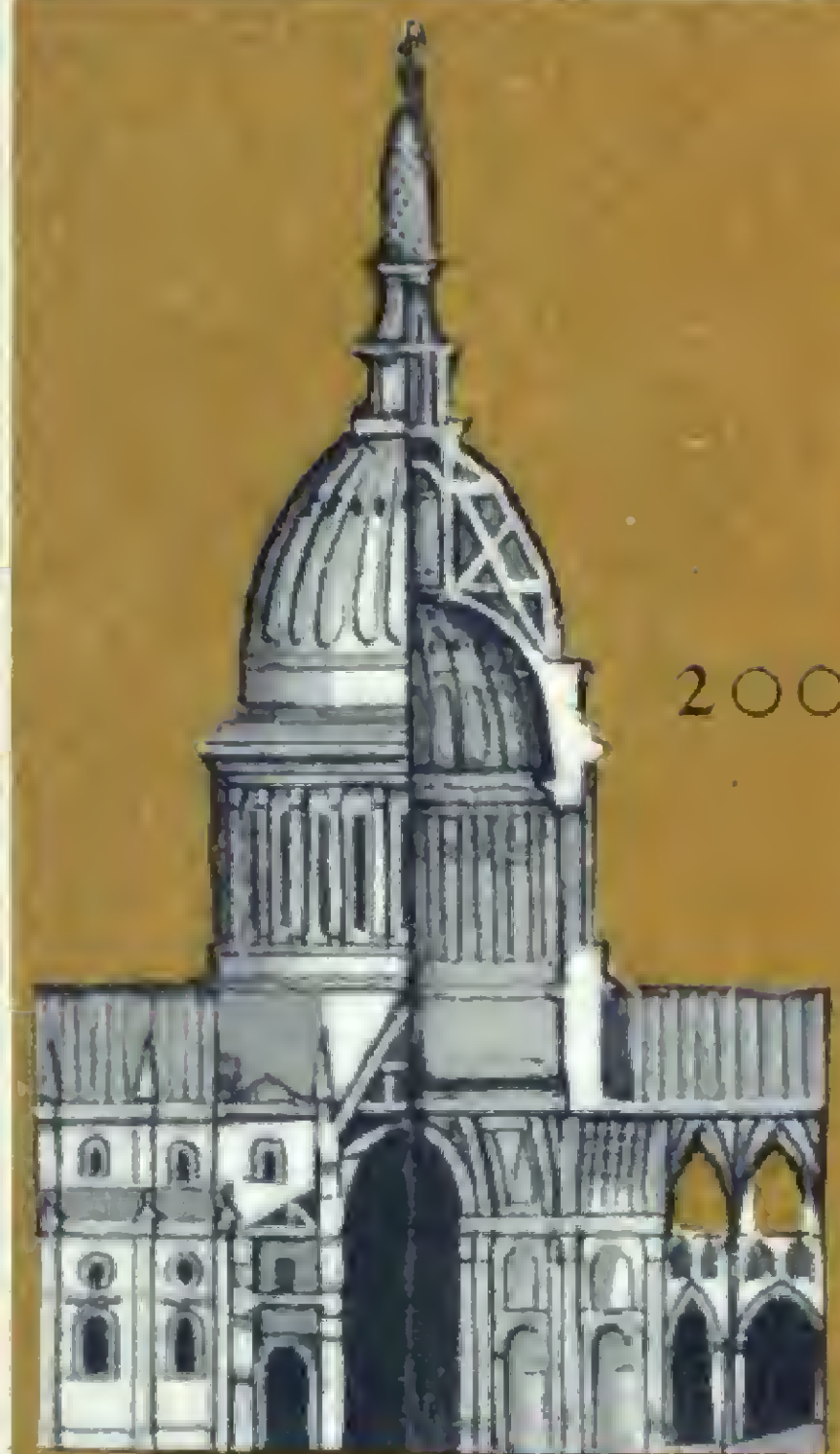
*Fernando
de Casas y Novoa*
(fl. 1711-94)



Charterhouse sacristy, Granada, 1713-47.

Designed by *Francisco Hurtado* (1669-1725), begun 1730
by *Luis de Arévalo* (1727-64), stonemason; plasterwork by *Luis Cabello*

RENAISSANCE - BAROQUE



Pre-Fire Design for
a domed crossing,
'in a Latine style'
1666



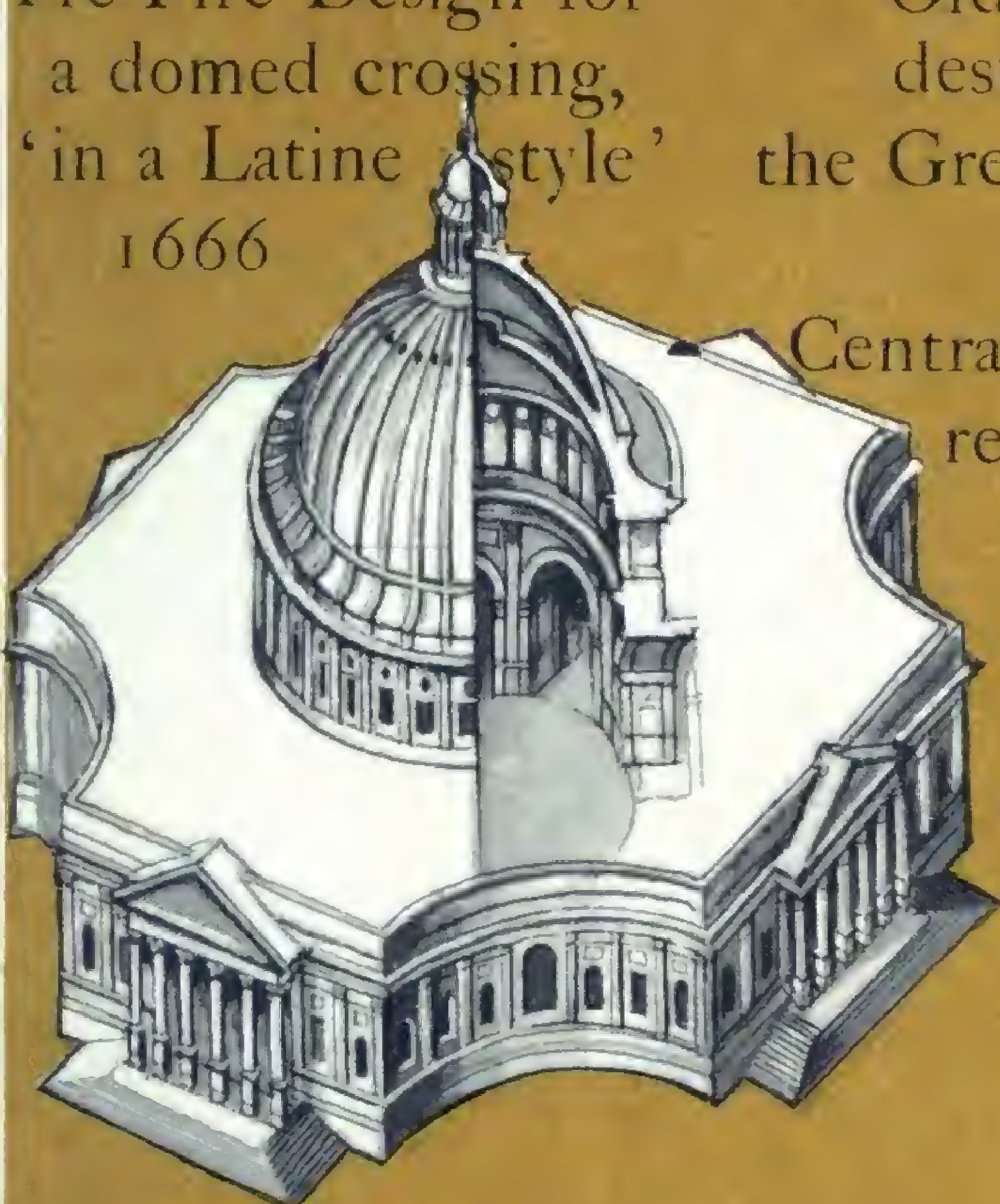
Old St Paul's,
destroyed in
the Great Fire, 1666



The Pantheon Design
c. 1668-69



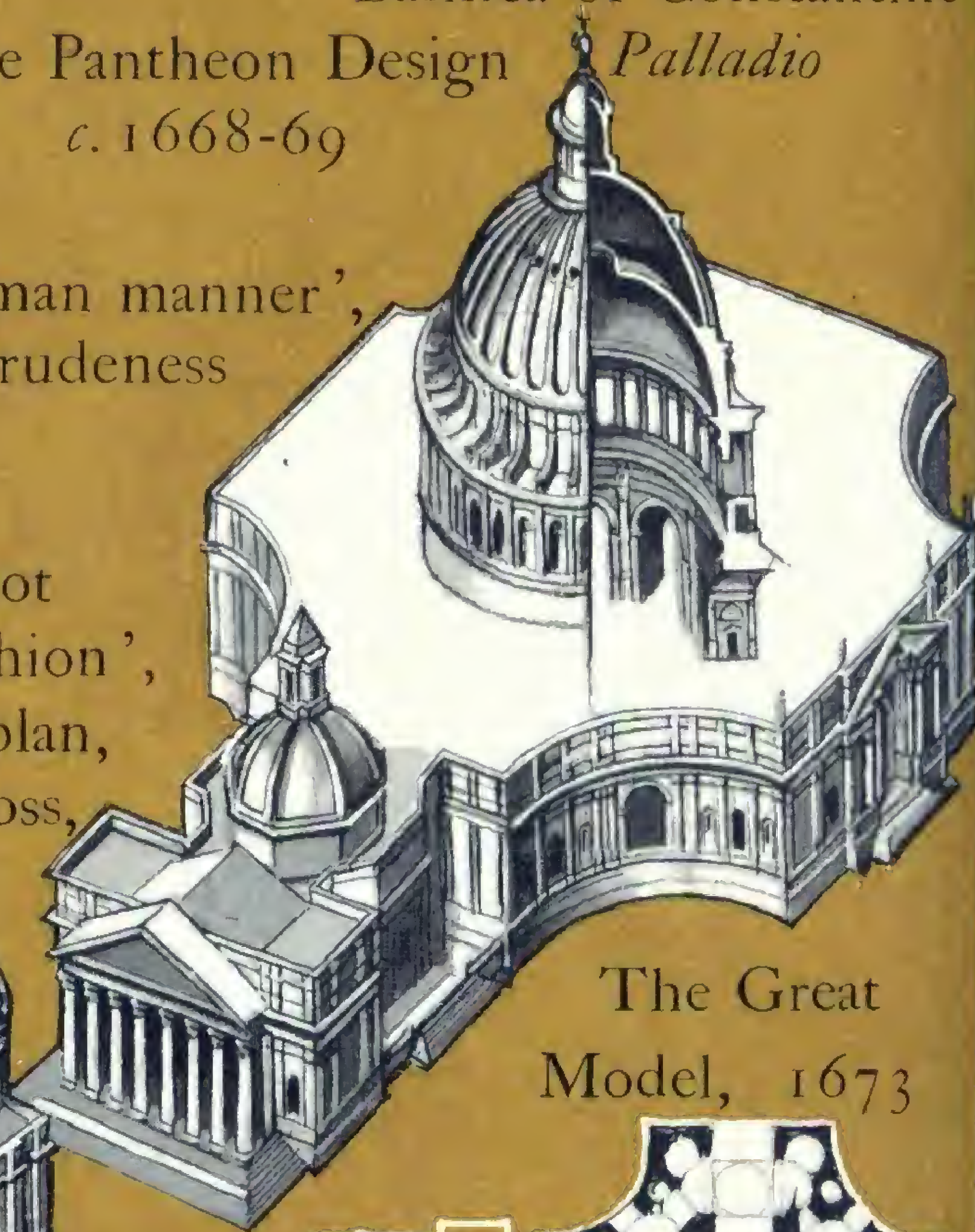
Basilica of Constantine
Palladio



Greek Cross Design, c. 1672

Centralized designs 'after a Roman manner',
remote from 'the Gothick rudeness
of ye old Design'.

The chapter
'thought the model not
enough of a cathedral fashion',
and a longitudinal plan,
based on the Latin Cross,
was adopted.



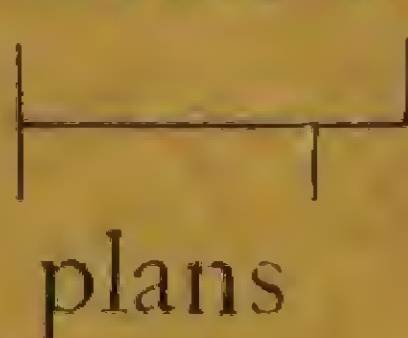
The Great
Model, 1673



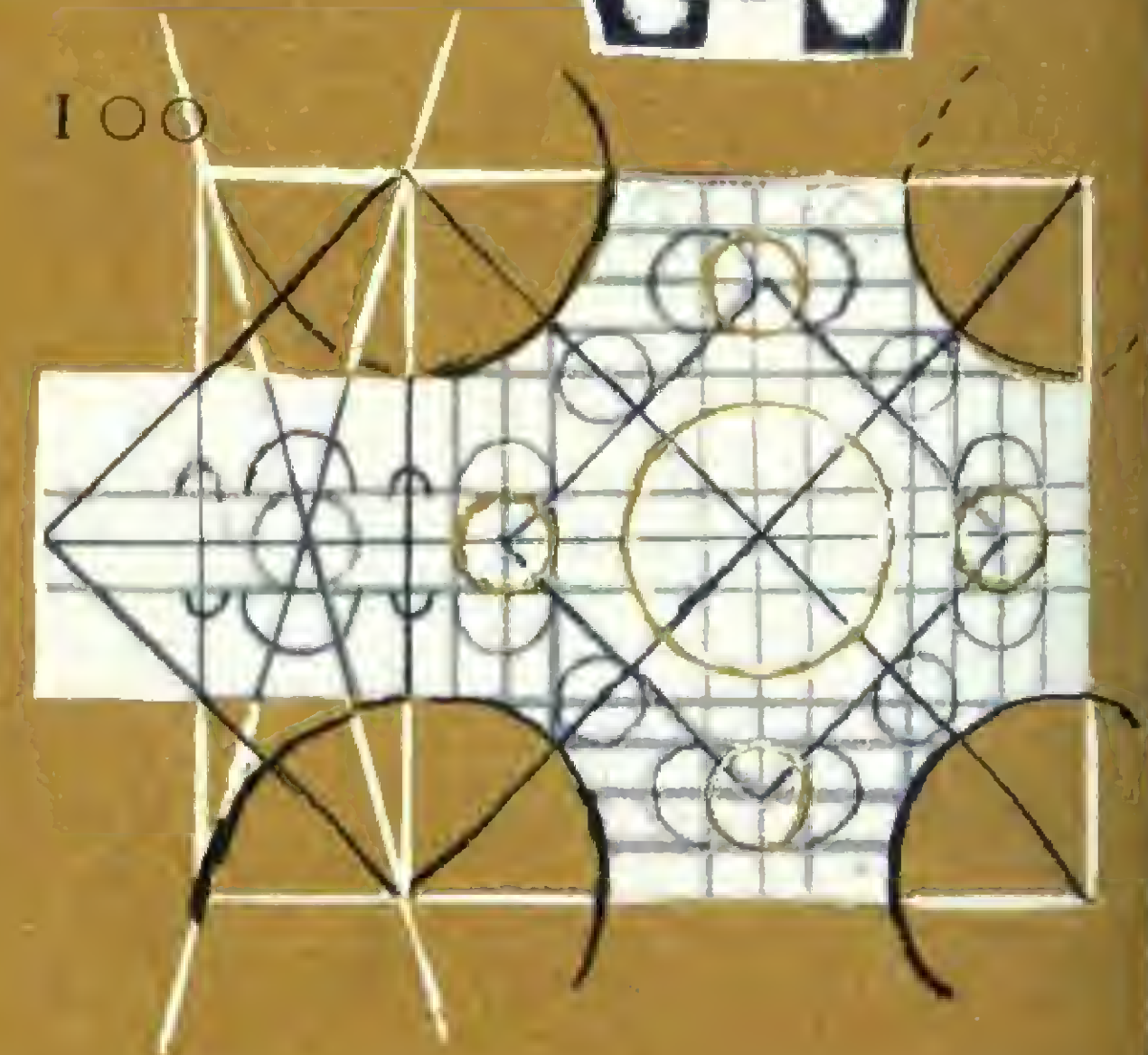
The Warrant Design, before 1675



elevations



plans



ENGLAND, WREN & THE BAROQUE

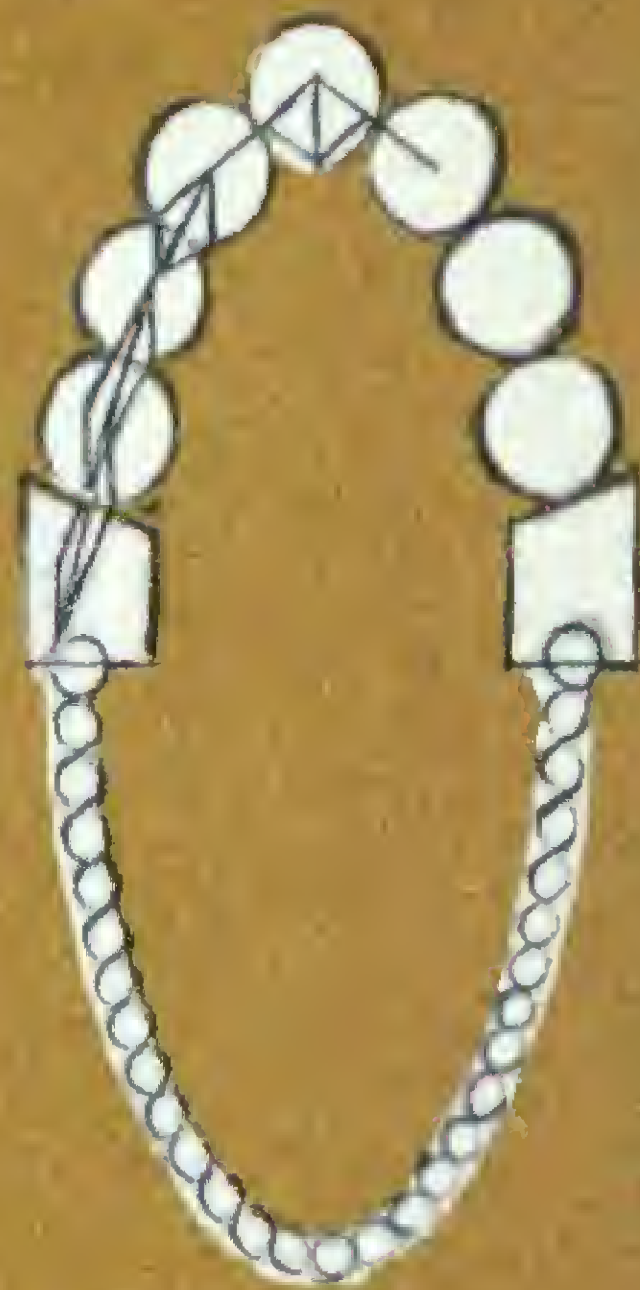
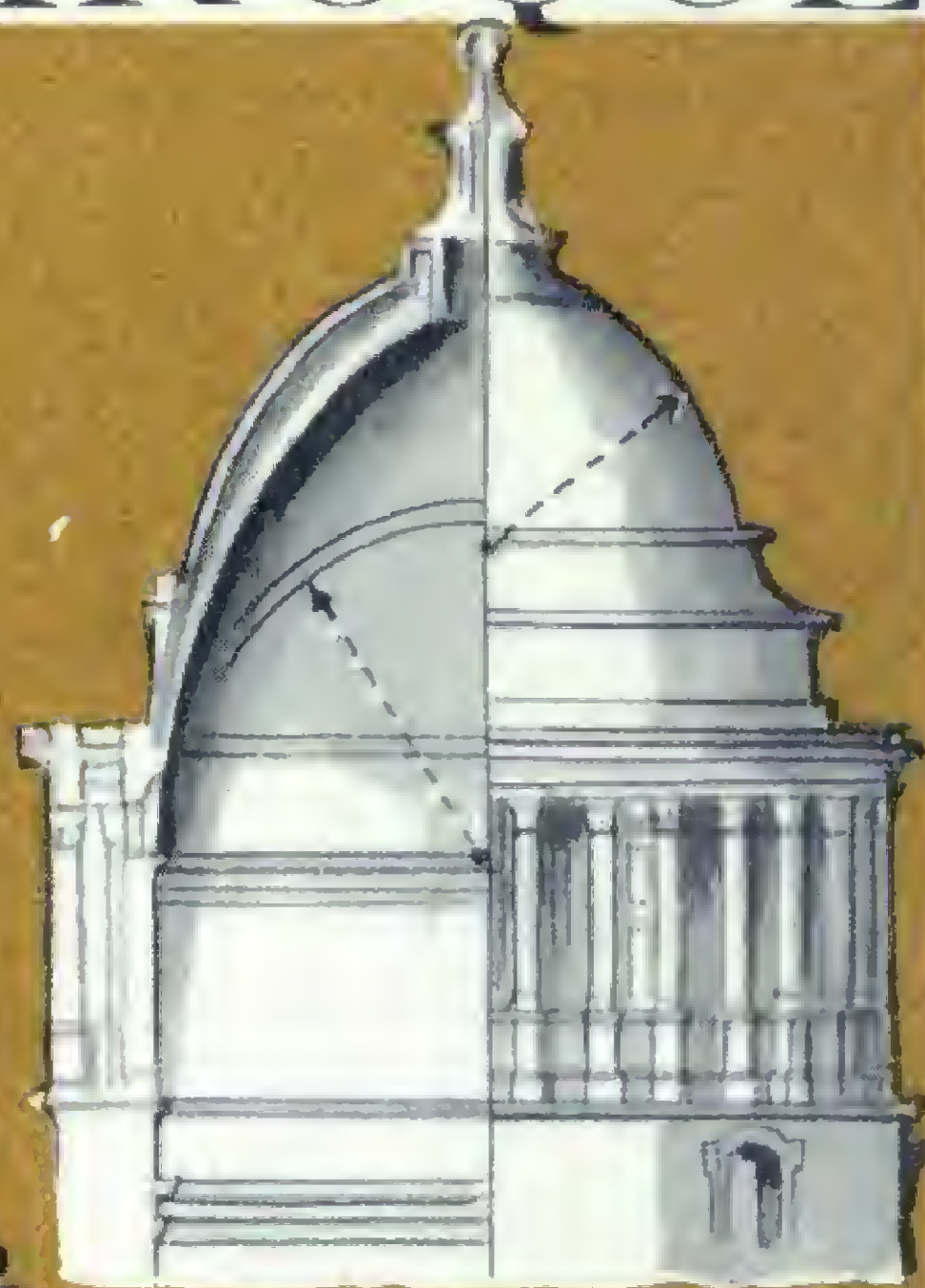


outer dome of timber
covered with
sheet lead,
on a brick cone
18" thick,
also
with an inner
brick dome
18" thick

355' 6"

C chains

Study
for
dome



The
mathematician
Robert Hooke
wrote that
Wren used the
'catenary line'

St Peter's, Rome:
dome *Bramante*
(1444-1514)
(from Serlio)

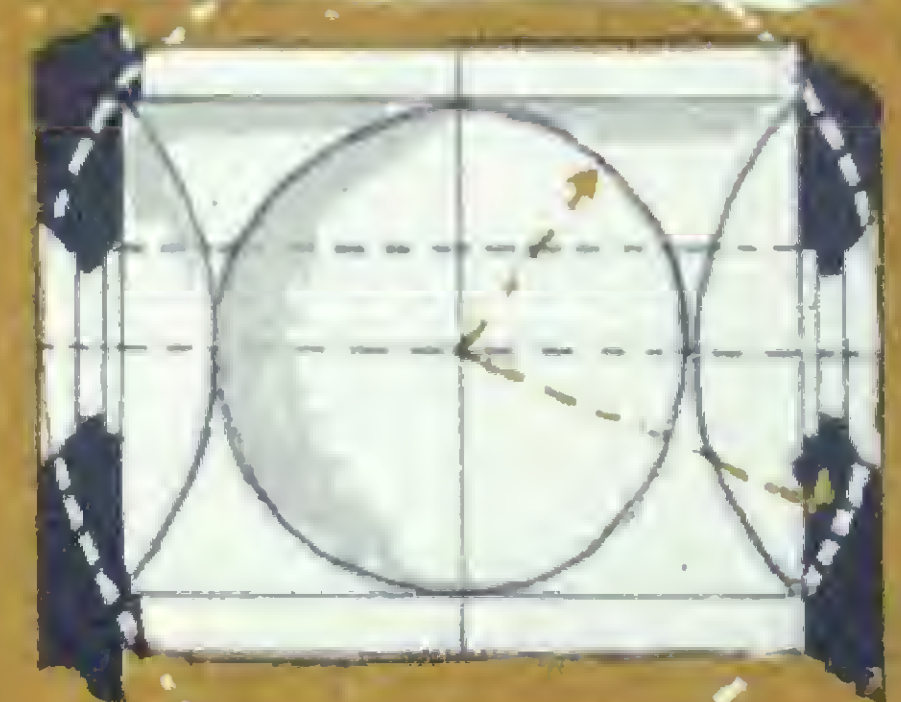
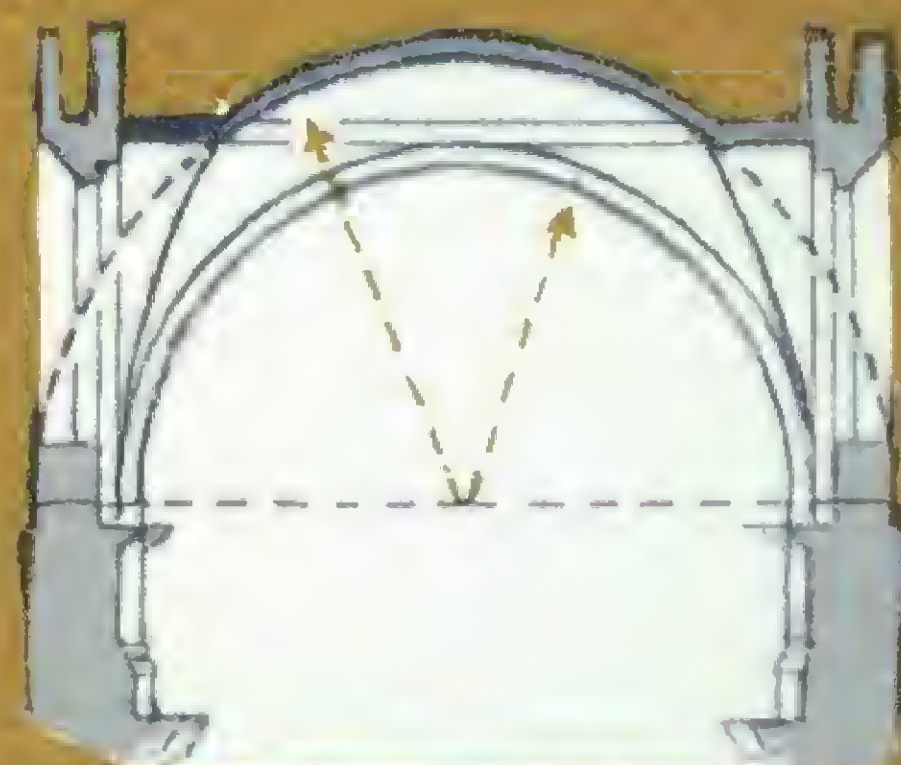


St Paul's Cathedral, London,
c. 1675-1711
Sir Christopher Wren
(1631-1723)

Vaulting of brick,
walls of ashlar stone
with rubble filling,
façades of Portland stone



Section
of nave



RENAISSANCE - BAROQUE

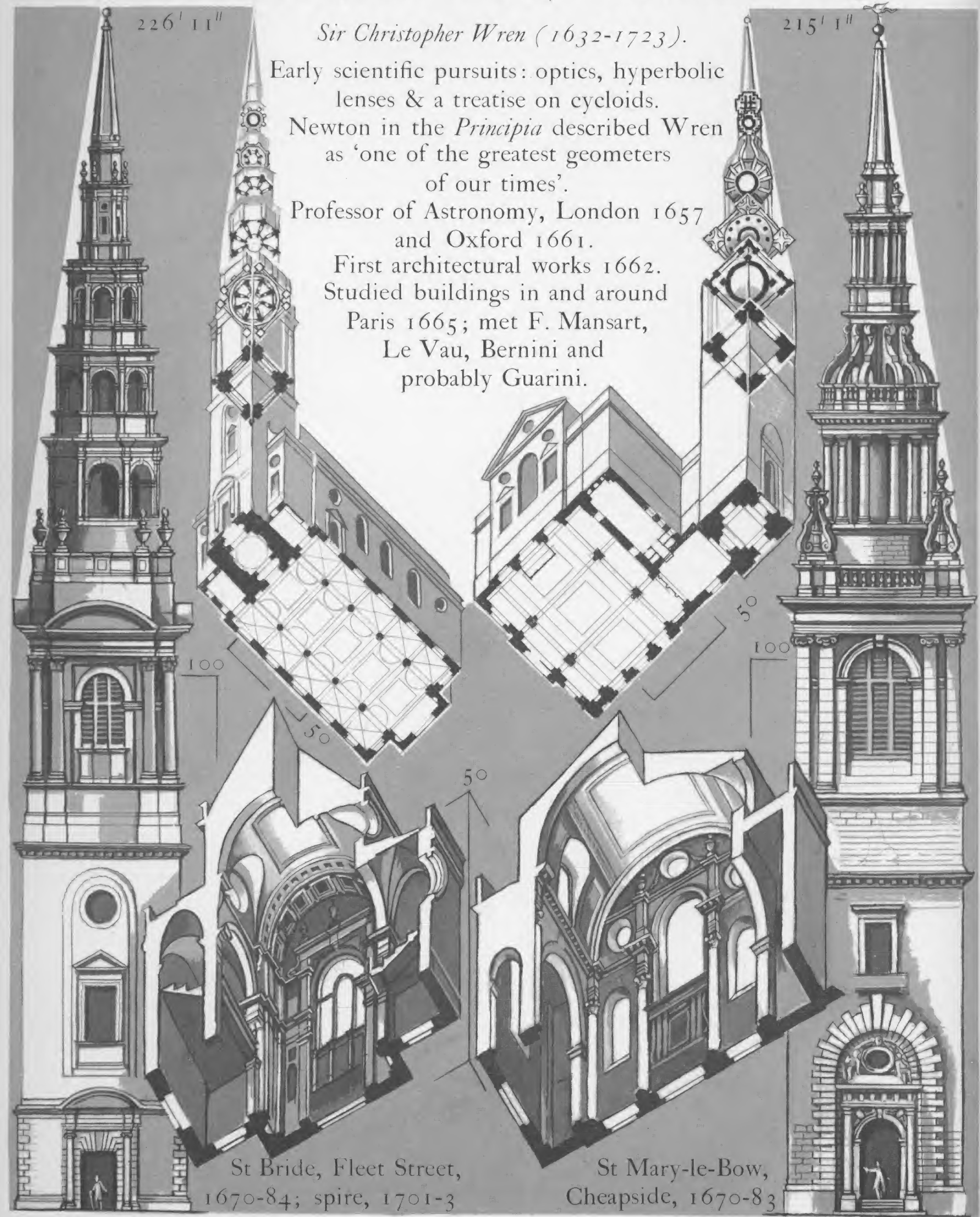
Sir Christopher Wren (1632-1723).

Early scientific pursuits: optics, hyperbolic lenses & a treatise on cycloids.

Newton in the *Principia* described Wren as 'one of the greatest geometers of our times'.

Professor of Astronomy, London 1657 and Oxford 1661.

First architectural works 1662.
Studied buildings in and around Paris 1665; met F. Mansart, Le Vau, Bernini and probably Guarini.

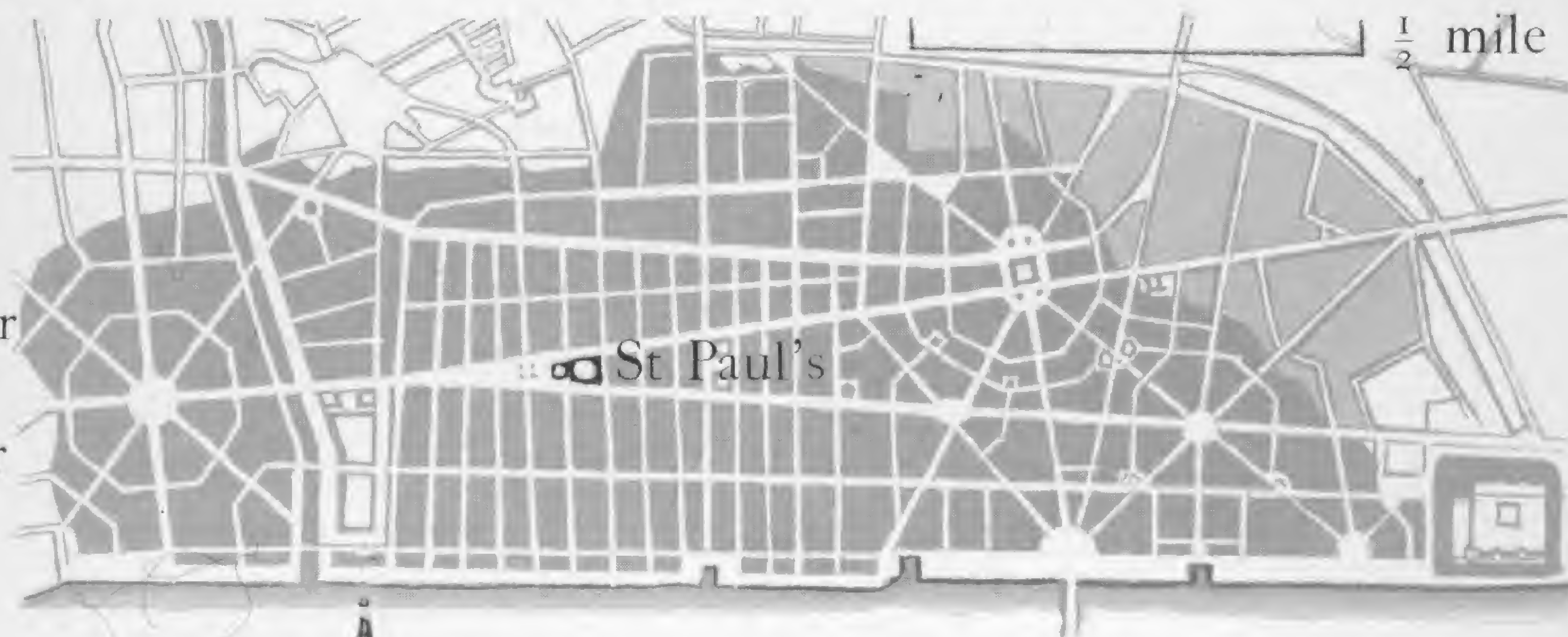


St Bride, Fleet Street,
1670-84; spire, 1701-3

St Mary-le-Bow,
Cheapside, 1670-83

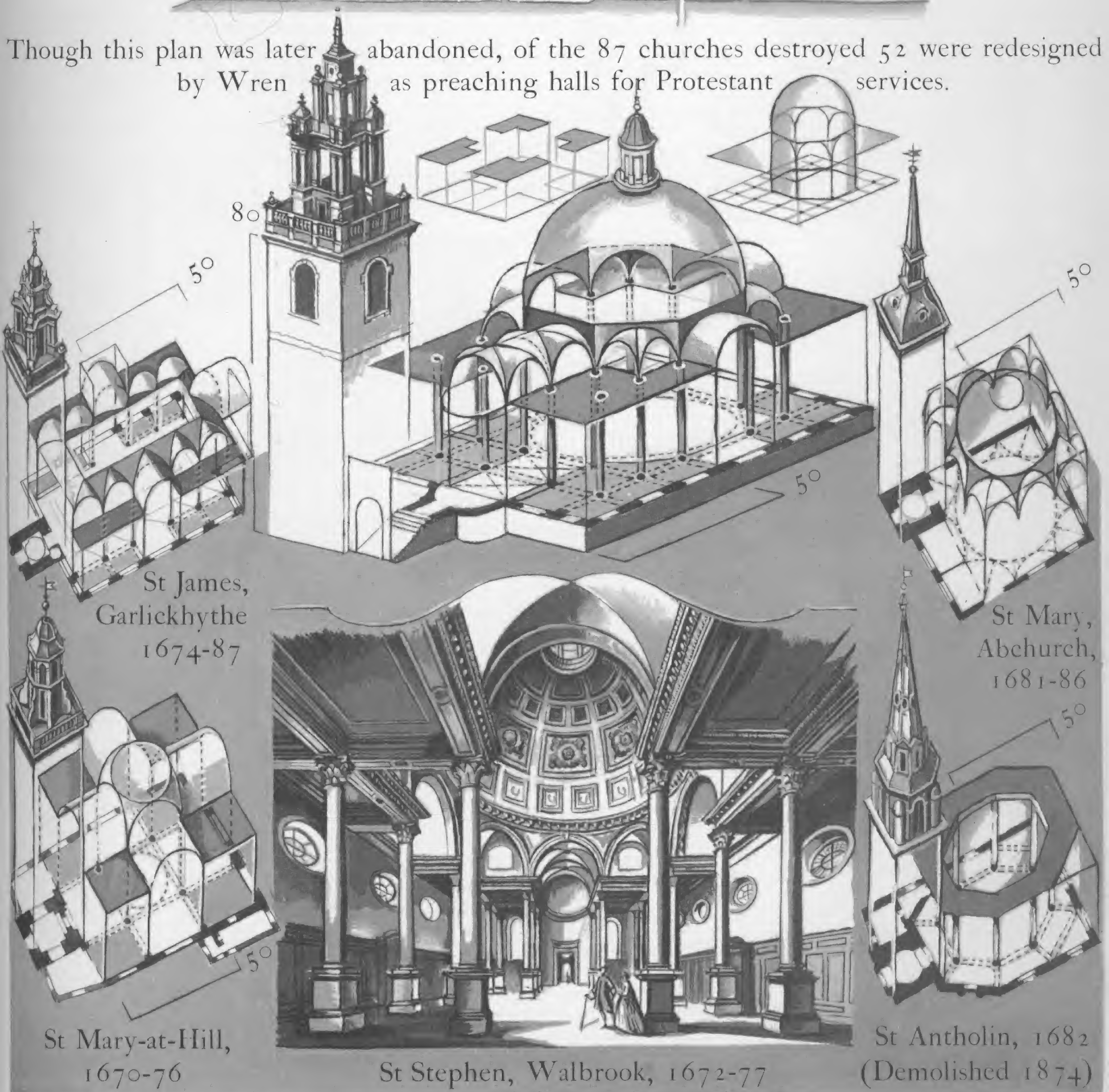
ENGLAND, WREN'S CITY CHURCHES

The fire of London lasted from 2-5 September 1666. On 11 September



Wren submitted a plan for rebuilding the City of London.

Though this plan was later abandoned, of the 87 churches destroyed 52 were redesigned by Wren as preaching halls for Protestant services.

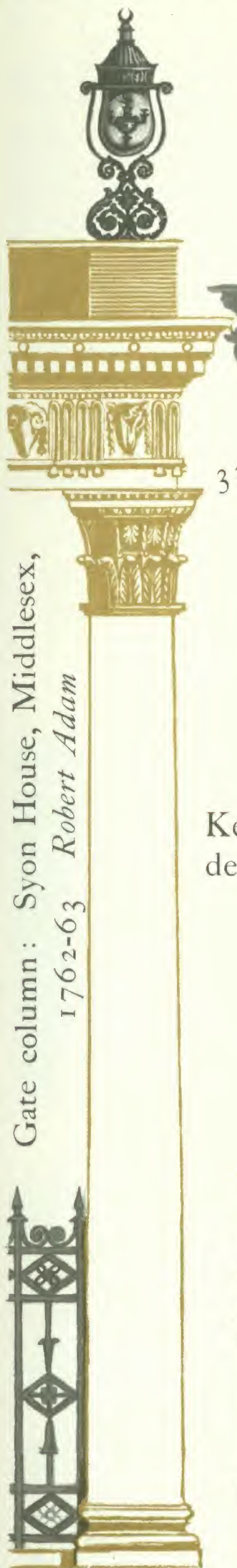


St Mary-at-Hill,
1670-76

St Stephen, Walbrook, 1672-77

St Antholin, 1682
(Demolished 1874)

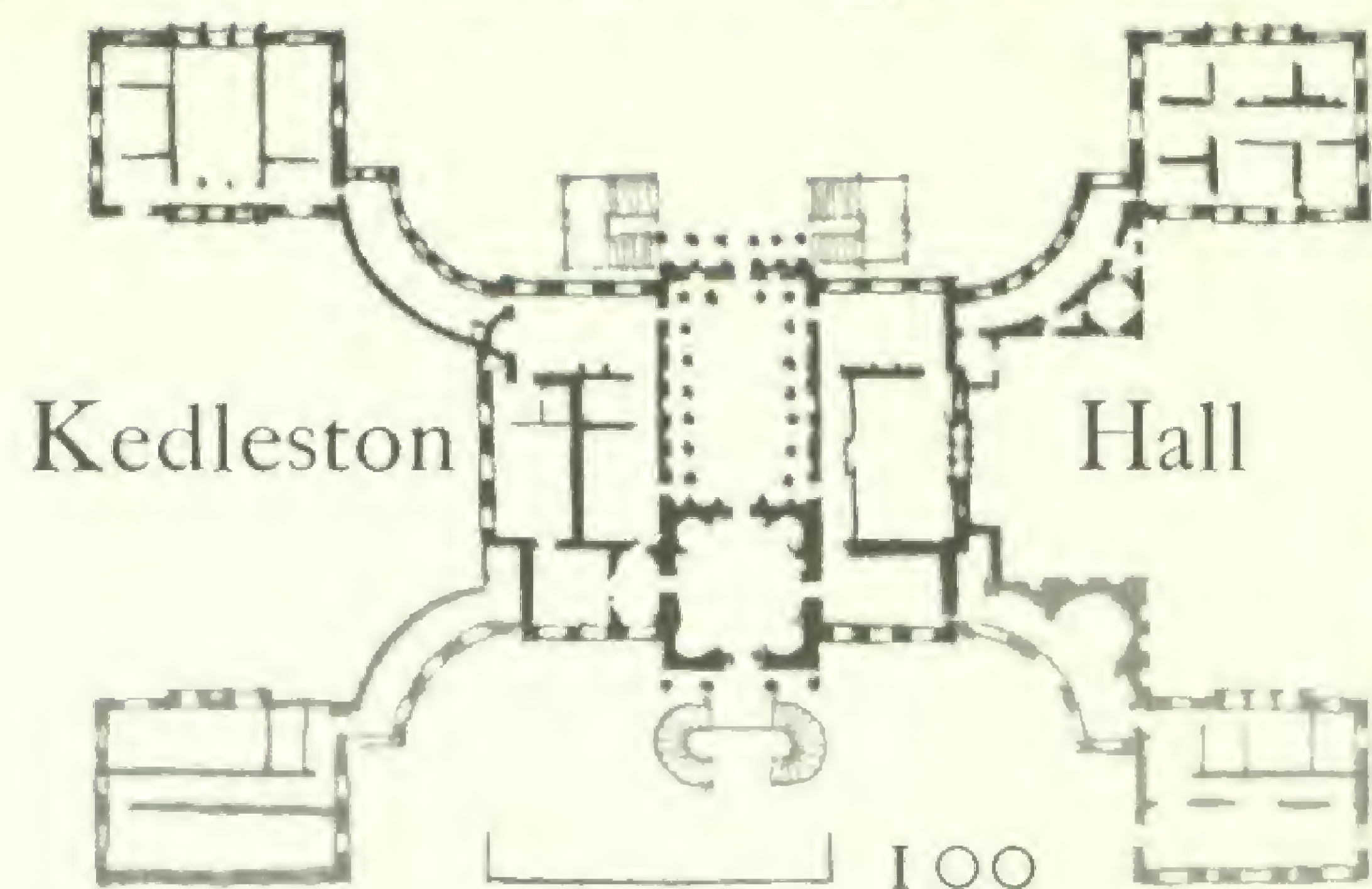
RENAISSANCE - BAROQUE



Gate column: Syon House, Middlesex,
1762-63 Robert Adam



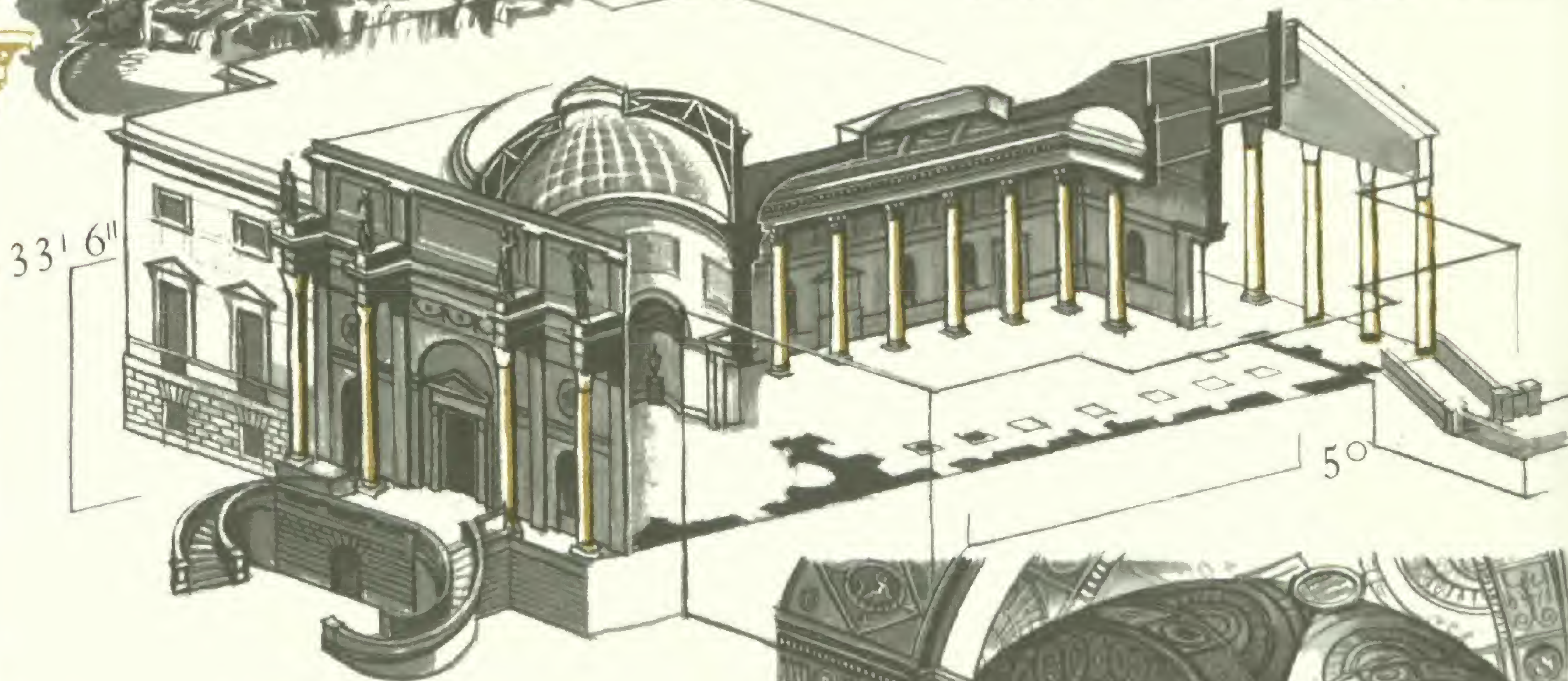
Fontana
Trevi,
Rome,
1732-1762
Salvi



Kedleston

Hall

100



Kedleston Hall, Derbyshire, 1756-70
designed by *James Paine* (1725-89);
south front & interior by
Robert Adam (1728-92).
Studied in Italy 1754-58



26, Grosvenor Square, London,
1773-74 *Adam* (demolished 1862)



Pitzhanger Place, Middlesex,
1800-1803

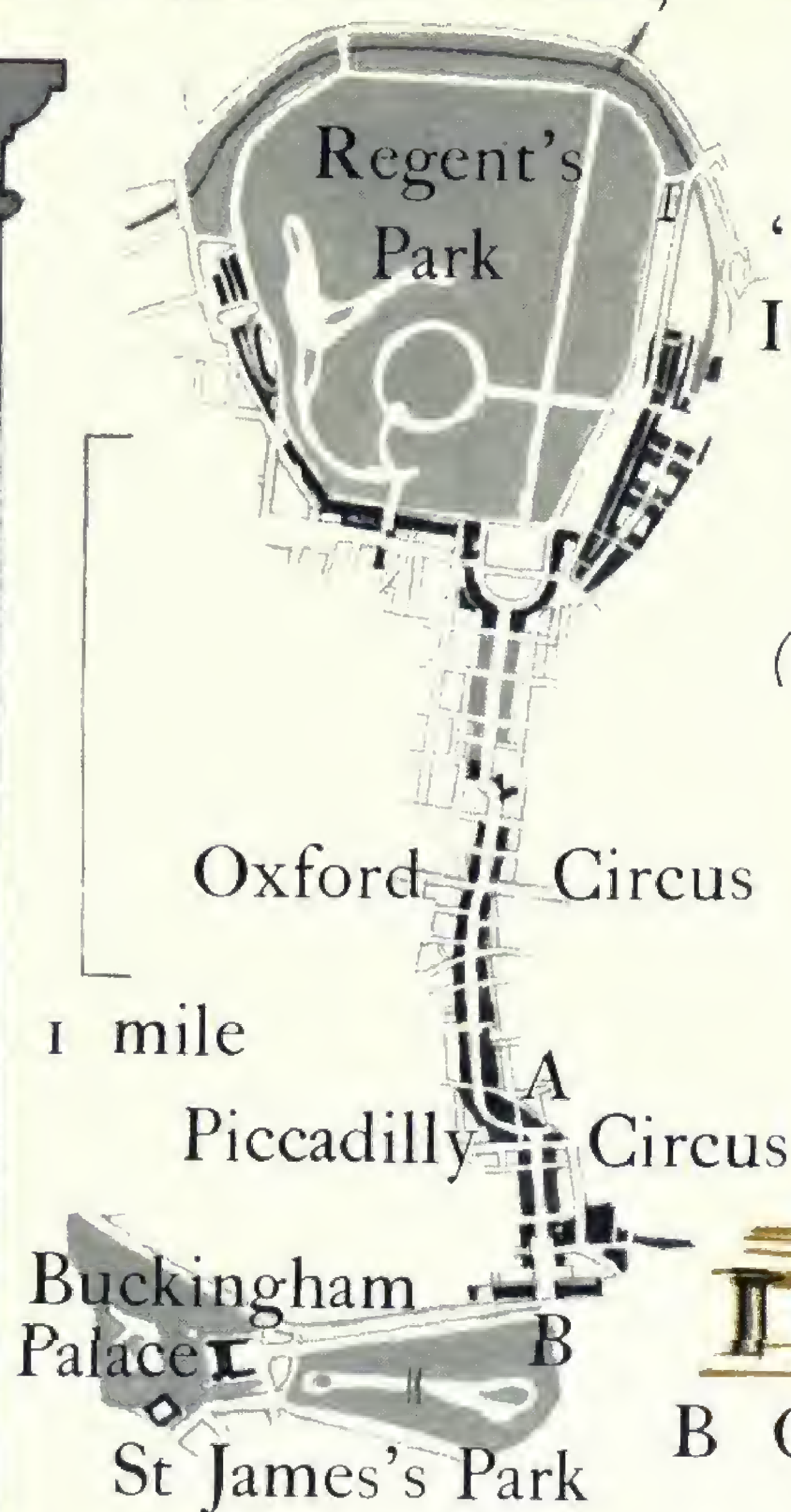


Bank Stock Office, Bank of England,
1792-93 (demolished 1927)

Sir John Soane (1753-1837) Visited Italy 1778-1780

ENGLAND, STONE, BRICK & IRON

section of cast-iron column Watt & Boulton
Mill, 1801:



London's
'Metropolitan
Improvements'
1812-1835

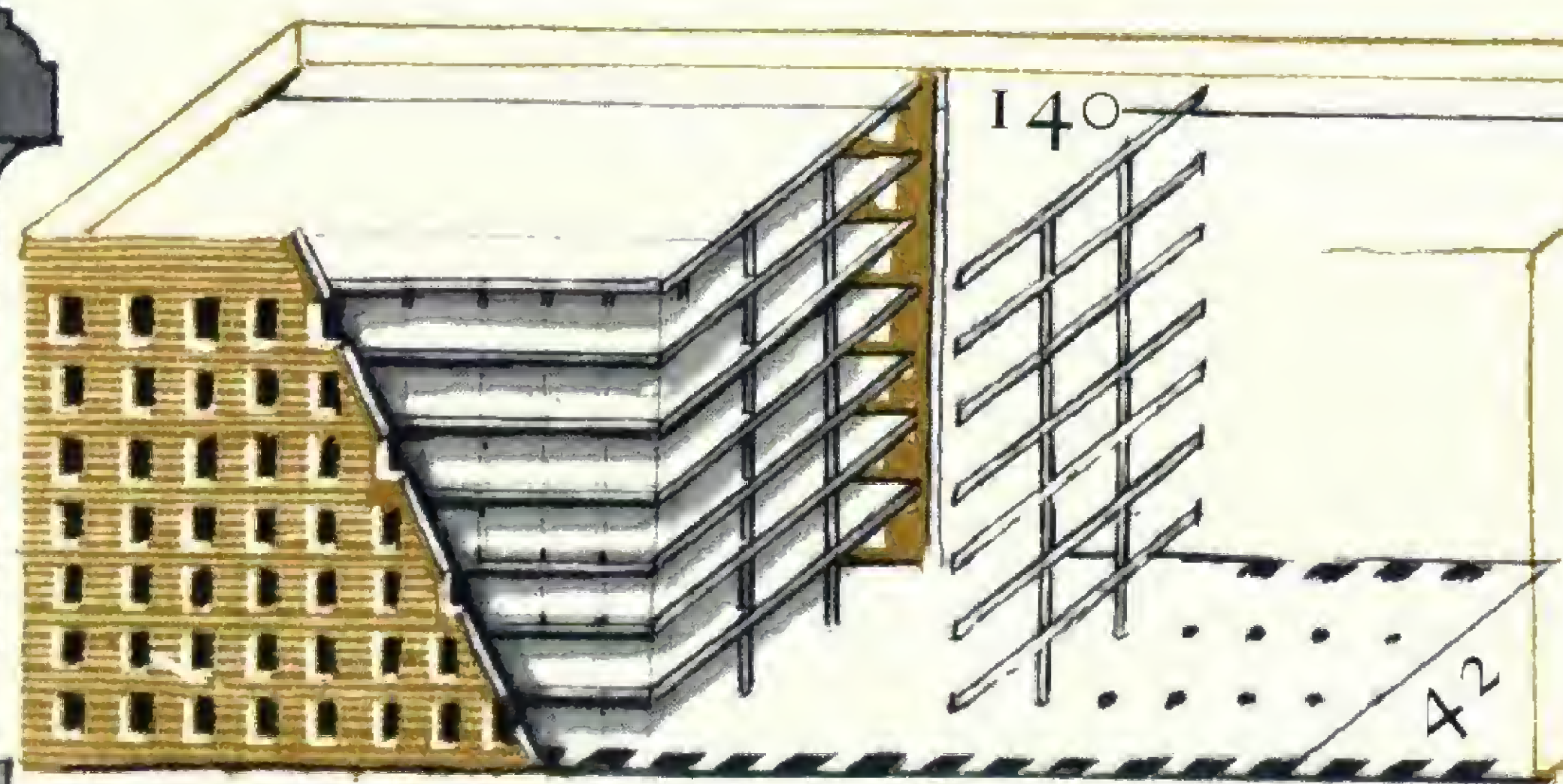
John Nash
(1752-1835)



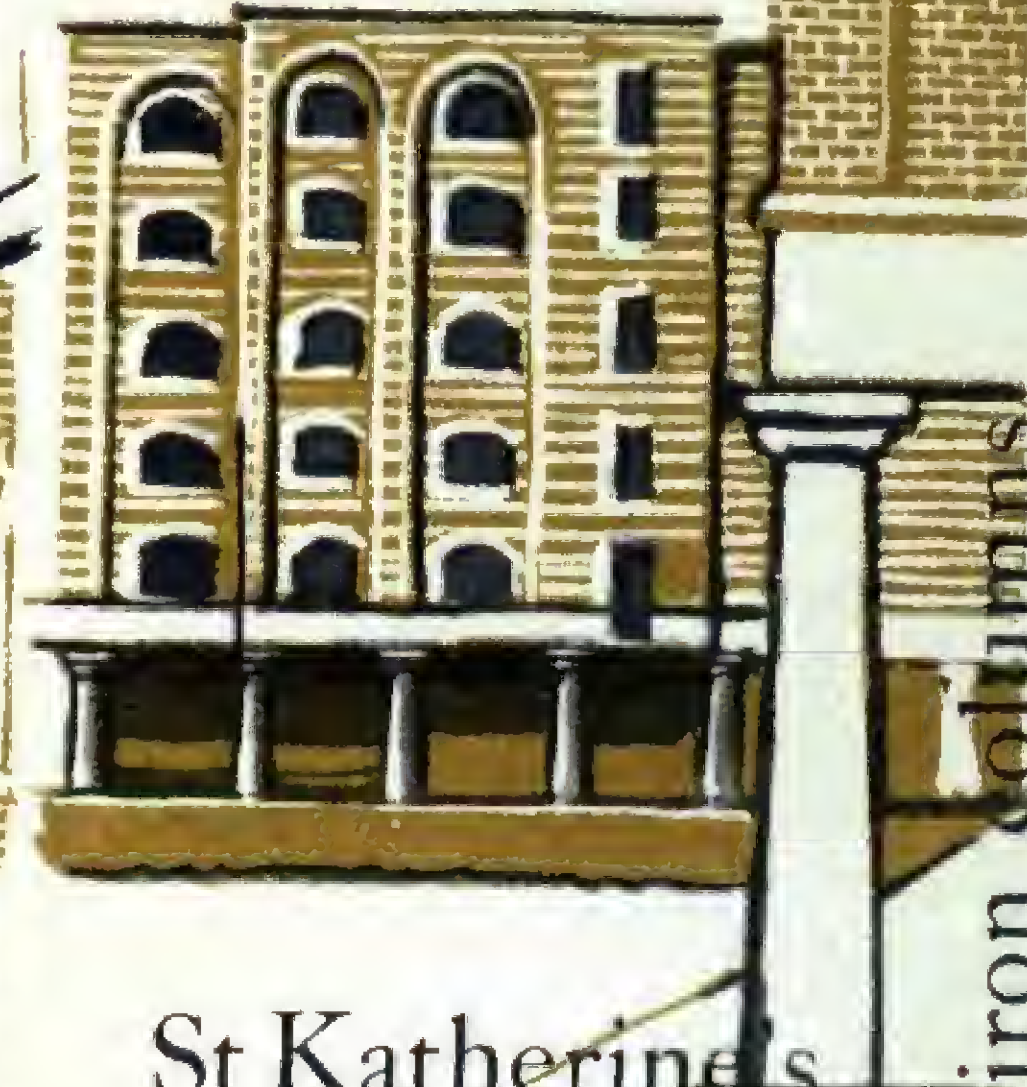
A The Quadrant, Regent Street 1818
Cast-iron columns



B Carlton House Terrace, 1827 Cast-iron Doric columns



Cotton mill, Manchester, 1801. Cast-iron columns & beams
James Watt (1736-1819) & *Matthew Boulton* (1728-1809)



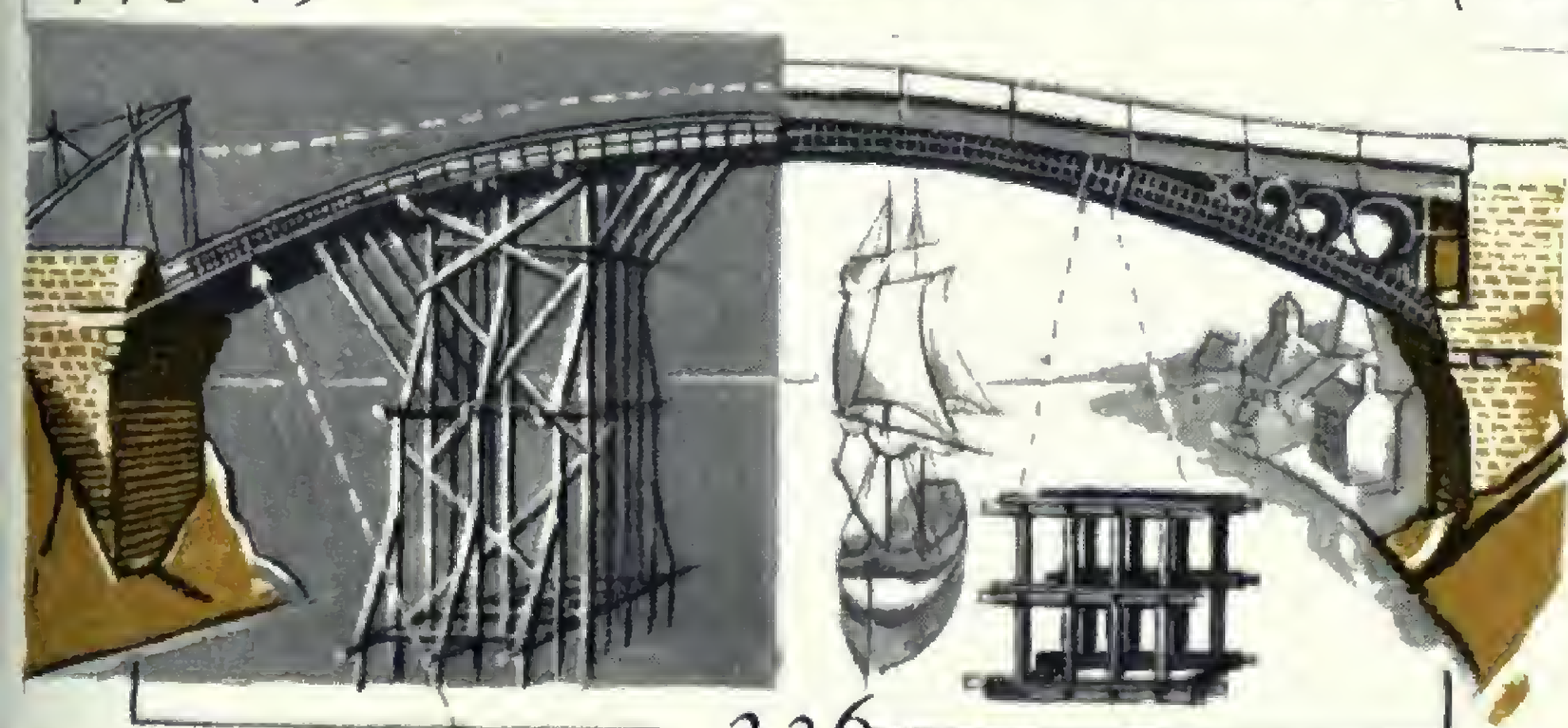
St Katherine's
Dock, London,
1828: *Telford*



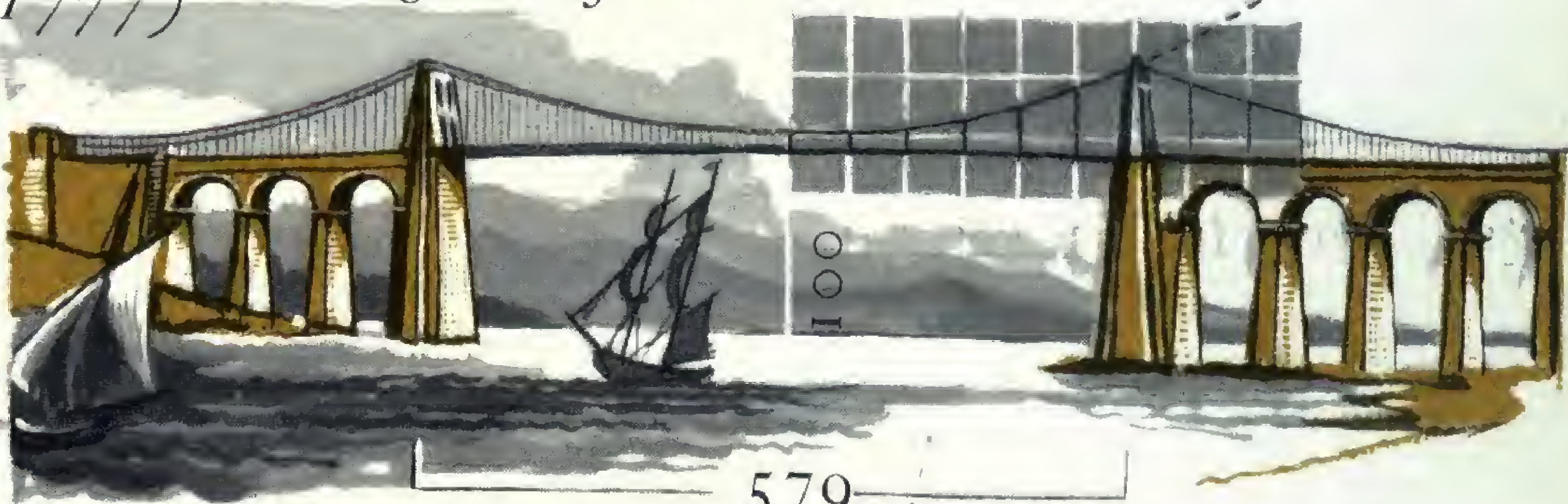
First iron bridge: Coalbrookdale, Shropshire,
1775-79 *Thomas Farnoth Pritchard* (d.1777)



Cast-iron rib-and-truss Bridge, Craigellachie,
1815 *Telford*

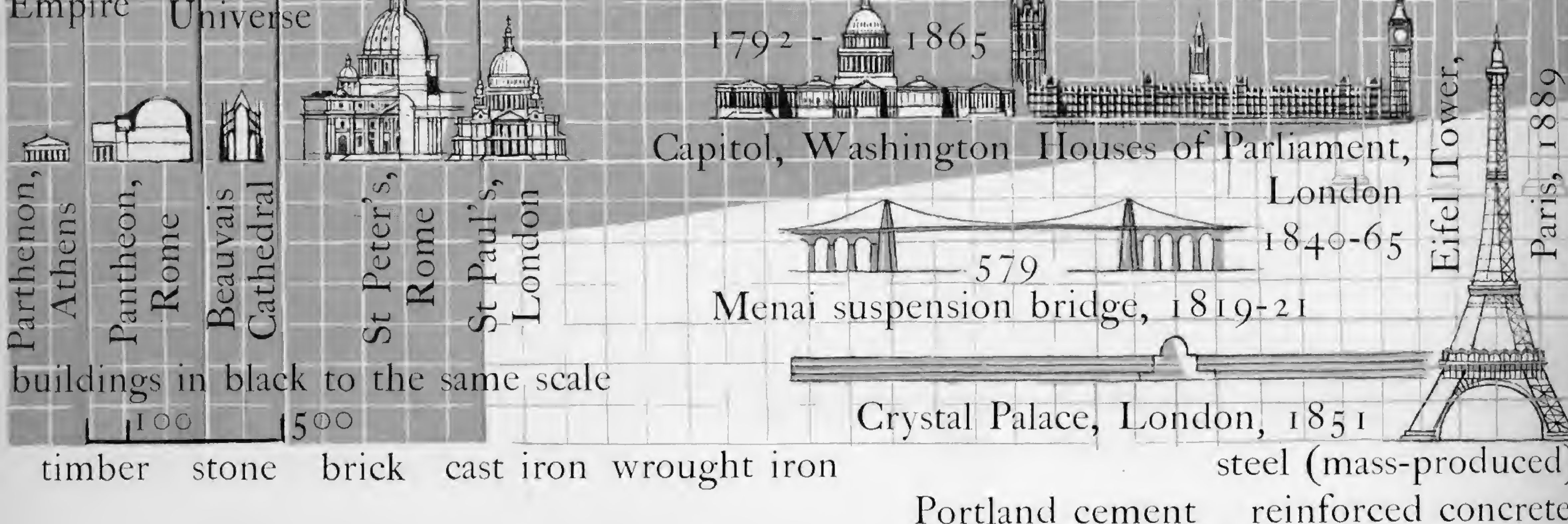
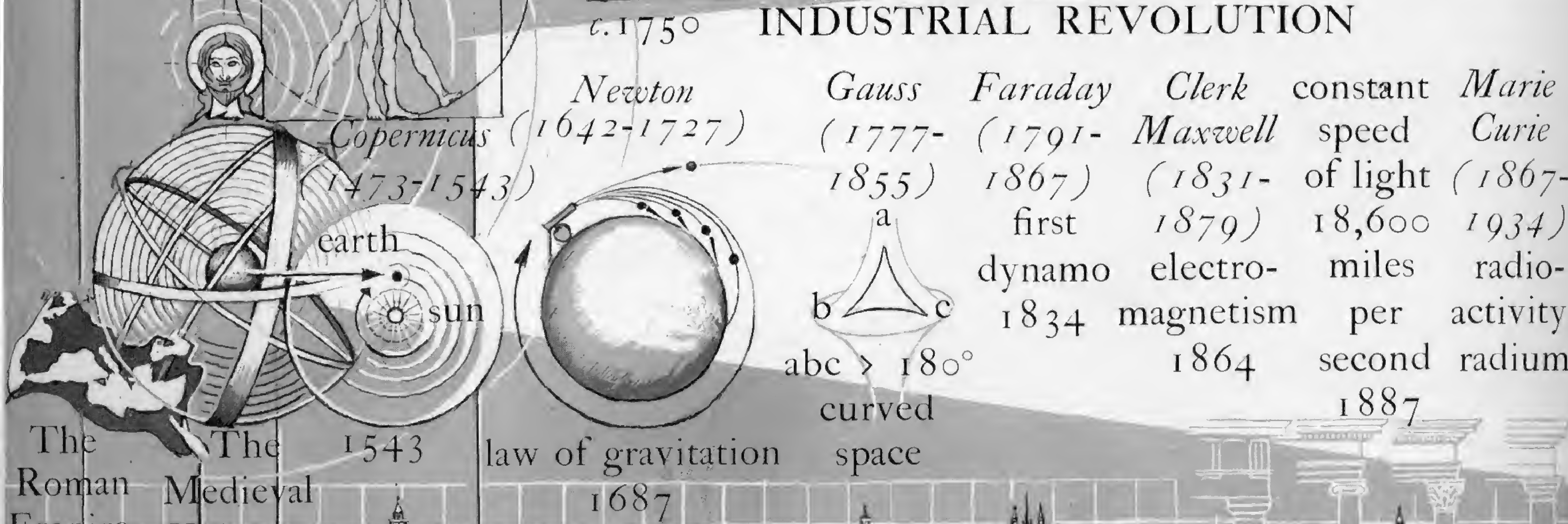
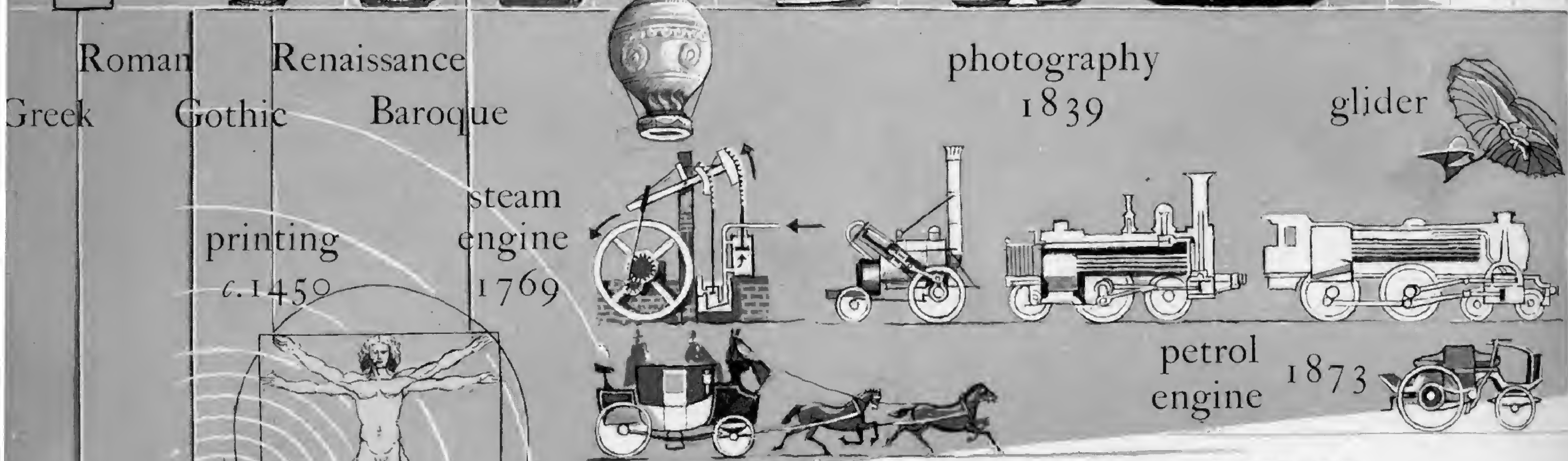


Cast-iron Bridge, Sunderland, 1793-96

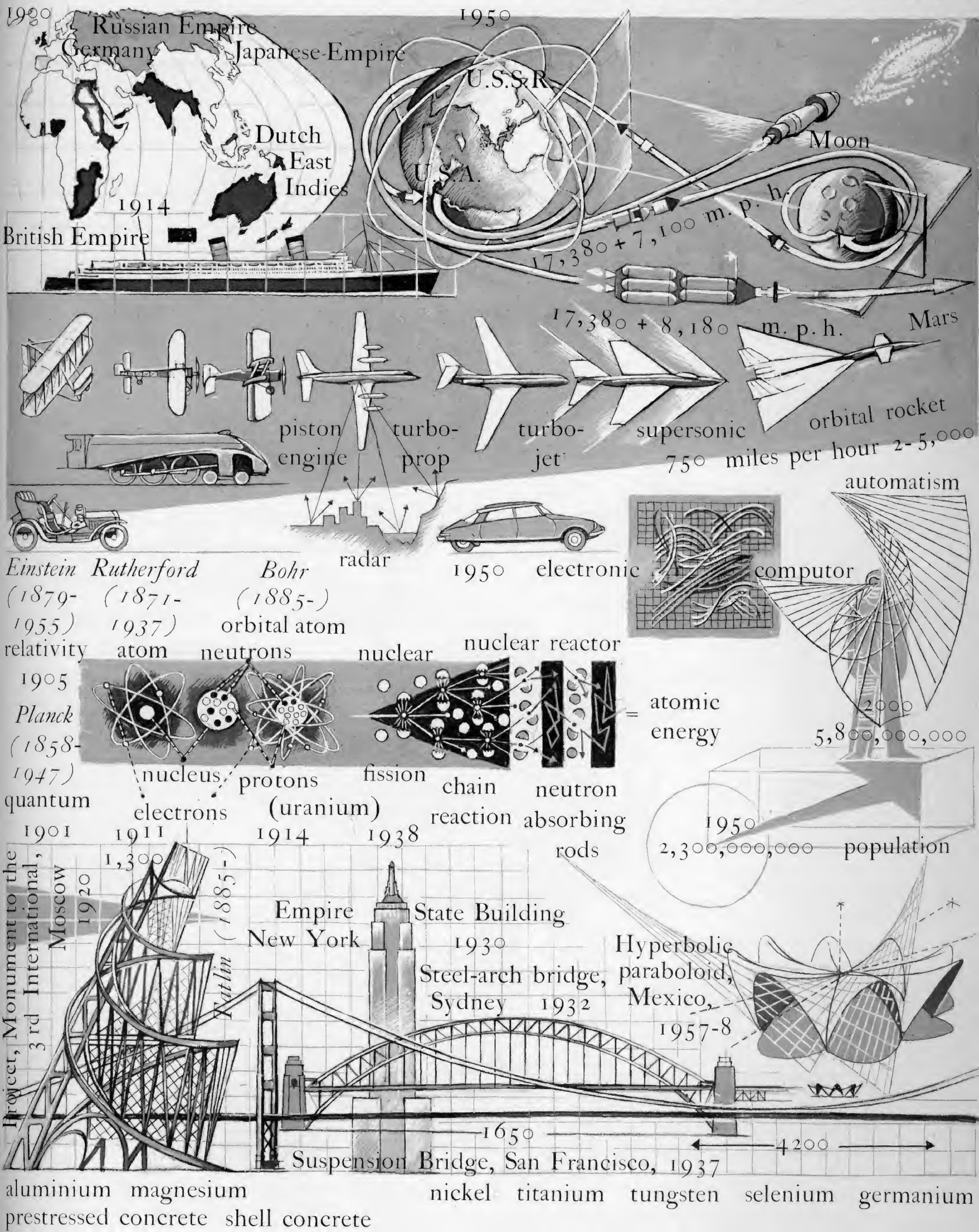


Suspension Bridge, Menai Straits, 1819-26
William Telford (1751-1834)

19TH & 20TH CENTURIES



INTRODUCTION



19 TH & 20 TH CENTURIES

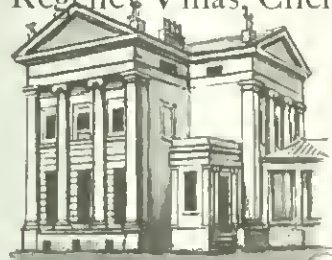


22 churches and chapels built by
Augustus Welby Northmore Pugin
(1812-52)

from frontispiece to
*An Apology for the
Revival of
Christian Architecture*,
1843

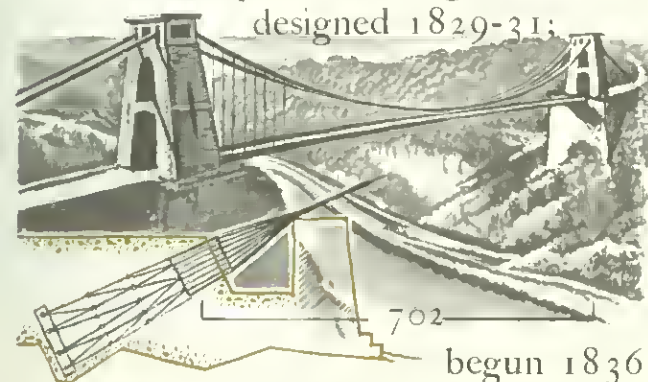


Regency Villas, Cheltenham,
c.1825



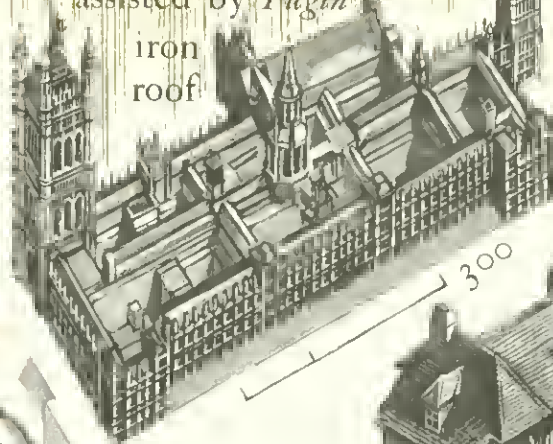
Classic

Clifton Suspension Bridge, Bristol,
designed 1829-31;



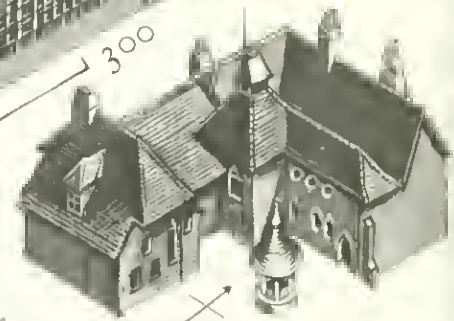
702 begun 1836
Isambard Kingdom Brunel (1806-59)

The Houses of Parliament,
London, 1840-65 Sir Charles
Barry (1795-1866),
assisted by Pugin



iron
roof

John Ruskin
(1819-1900),
*The Seven Lamps
of Architecture*,
1849
*The Stones
of Venice*,
1851



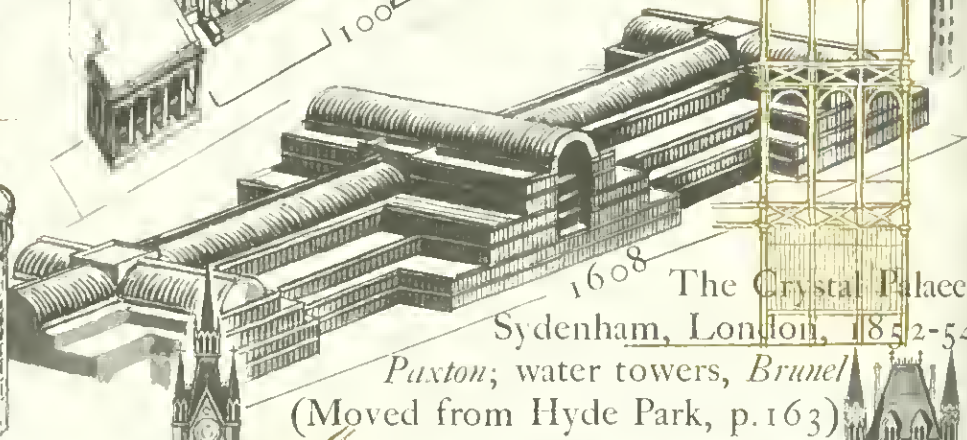
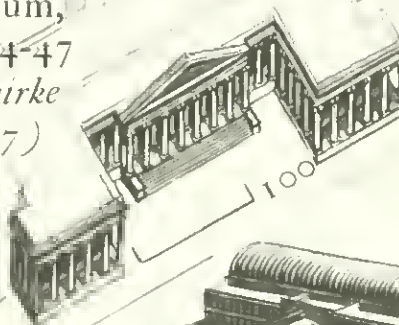
The Red House, Kent, 1859
Philip Webb (1831-1915)
for William Morris
(1834-96)

British Museum,
London, 1824-47
Sir Robert Smirke
(1780-1847)

Gothic

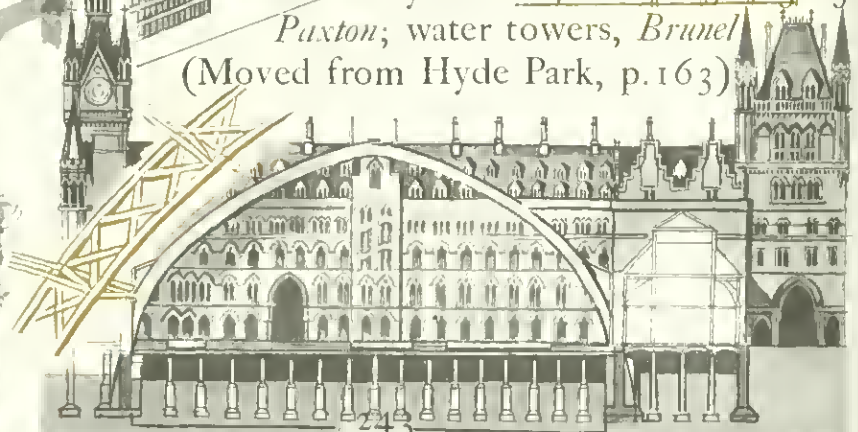


cast-iron
dome
Sidney Smirke
(1799-1877)



1608 The Crystal Palace,
Sydenham, London, 1852-54
Paxton; water towers, Brunel
(Moved from Hyde Park, p.163)

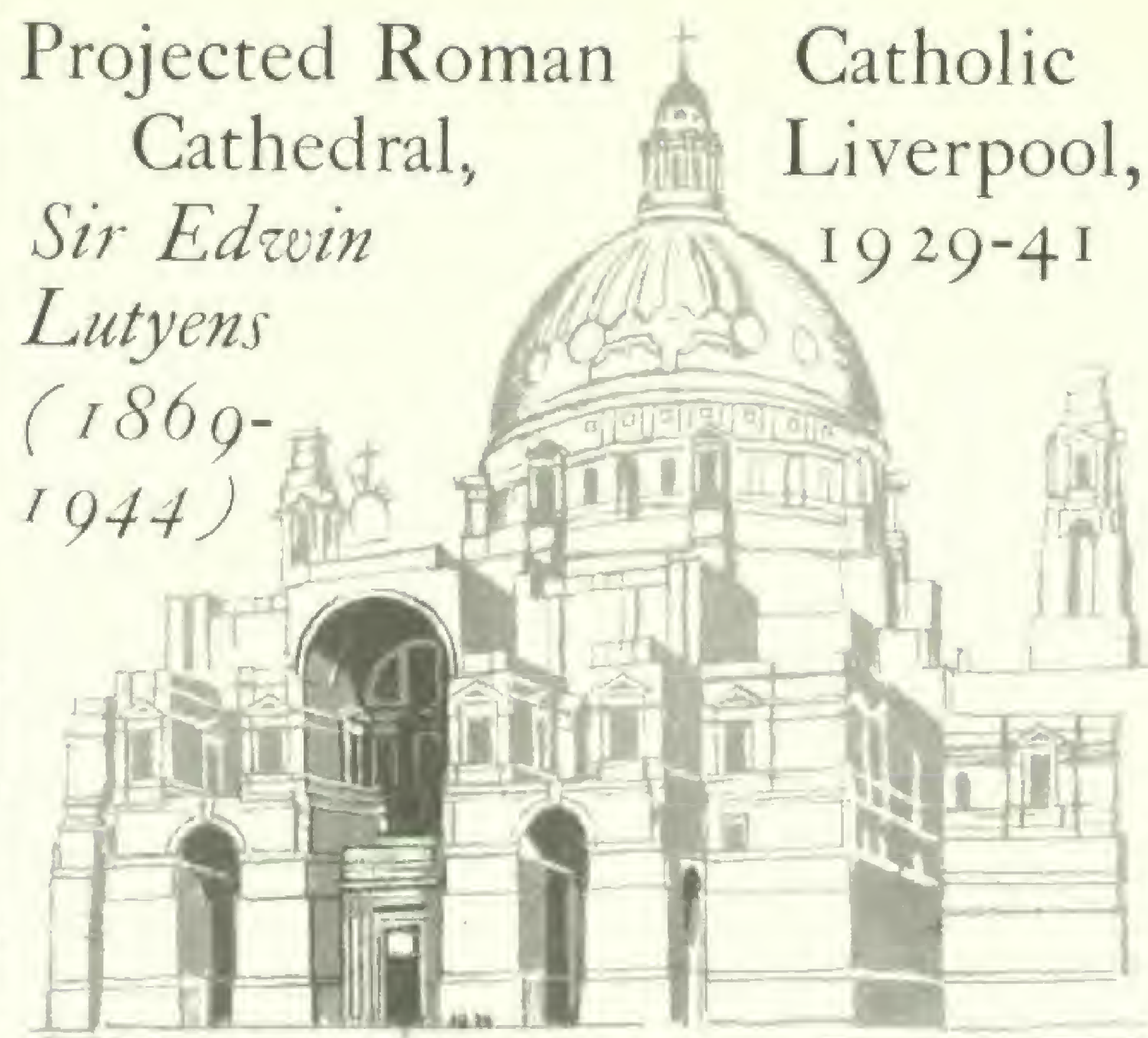
243 St Paneras Station, London, 1865-73. Engineers,
W.H.Barlow (1812-1902) & M.Ordish (1824-88)
Hotel, 1865-75 Sir George Gilbert Scott (1810-77)



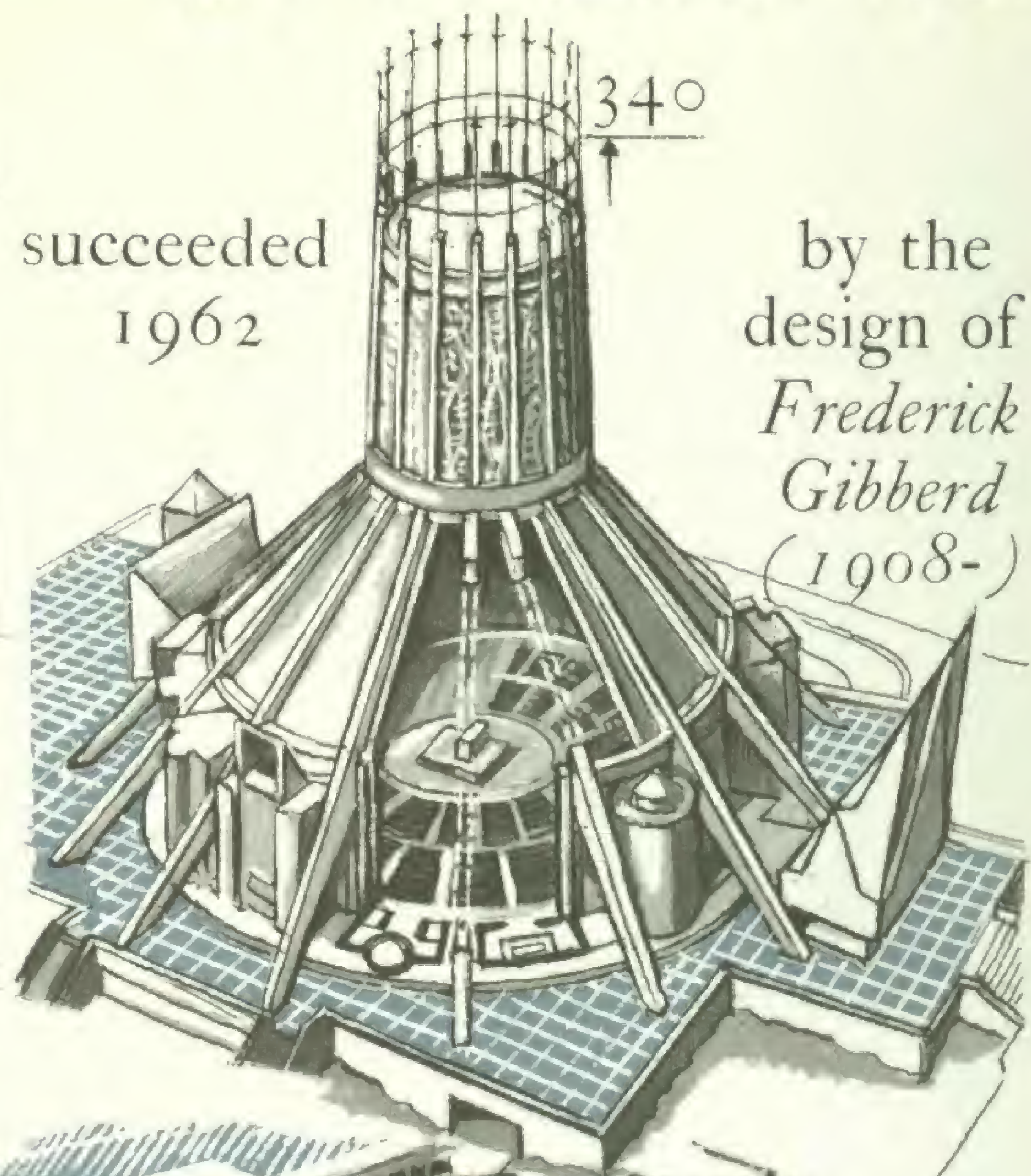
ENGLAND



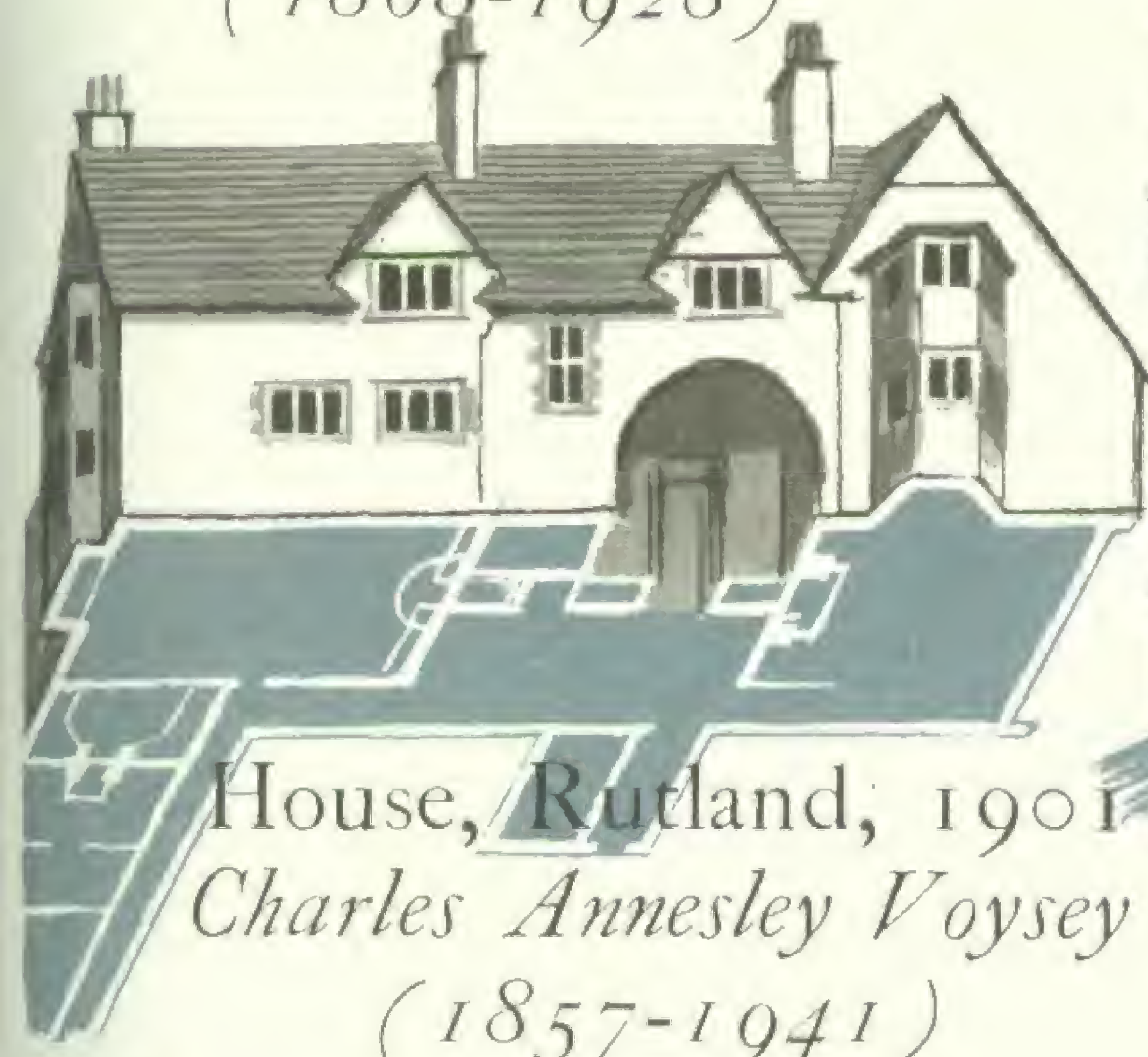
School of Art, Glasgow,
1896 Art Nouveau
Charles Rennie Mackintosh
(1868-1928)



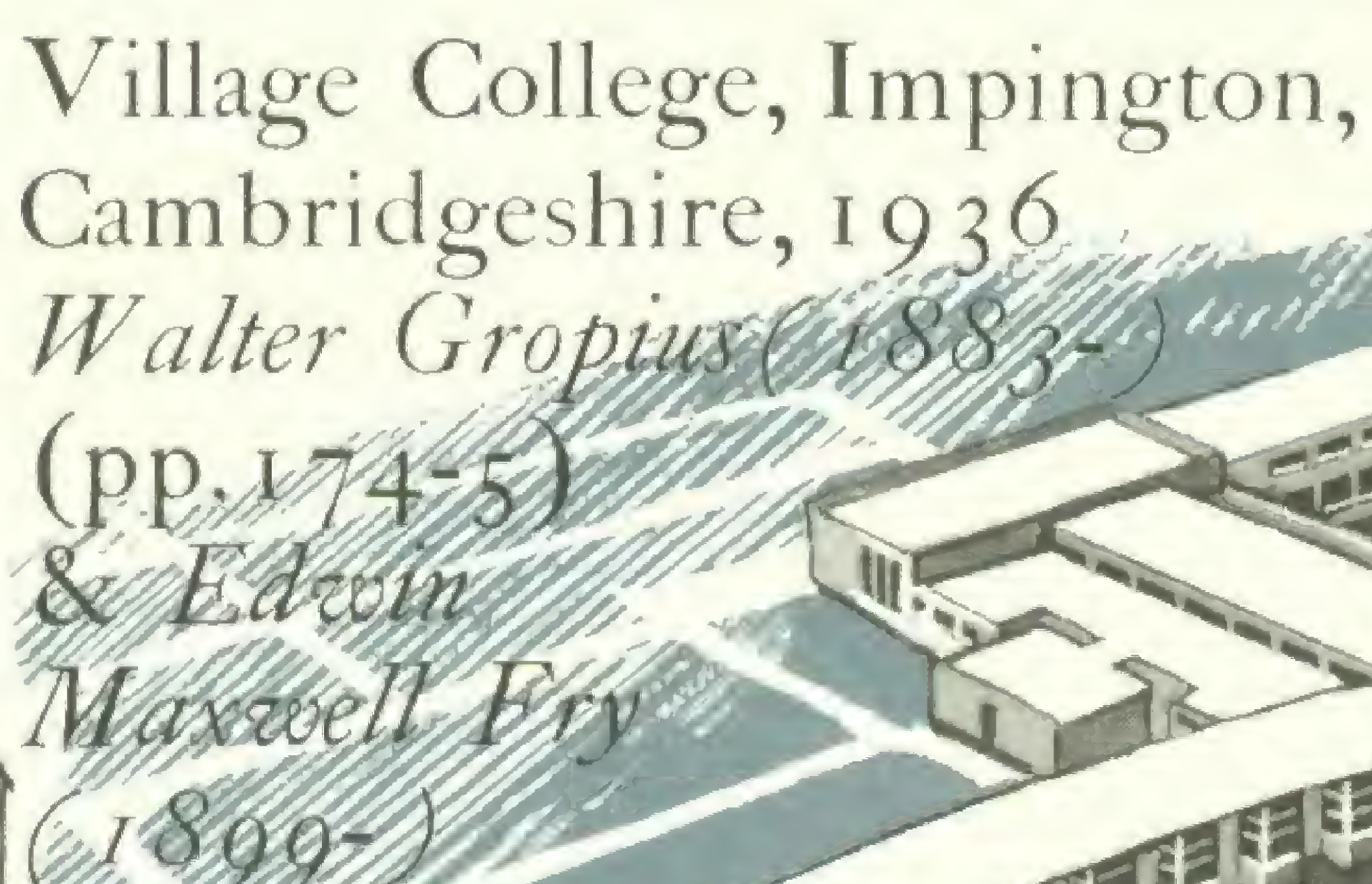
Projected Roman Catholic
Cathedral,
Sir Edwin Lutyens
(1869-1944)
Catholic
Liverpool,
1929-41 succeeded
1962



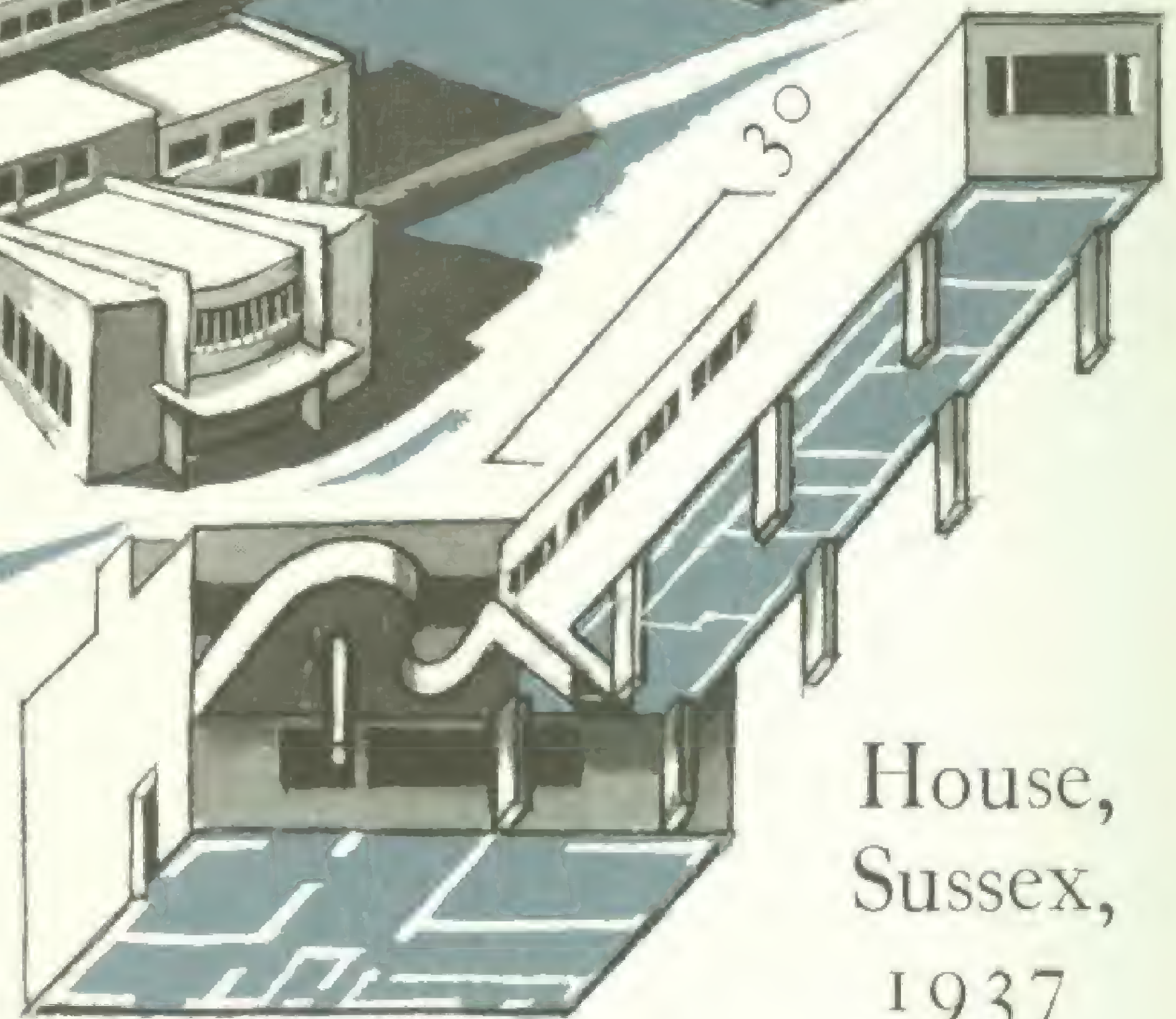
by the
design of
Frederick Gibberd
(1908-)



House, Rutland, 1901
Charles Annesley Voysey
(1857-1941)



Village College, Impington,
Cambridgeshire, 1936
Walter Gropius (1883-)
(pp. 174-5)
& *Edwin Maxwell Fry*
(1899-)



House,
Sussex,
1937
F. R. S. Yorke (1906-62)
& *Marcel Breuer* (1902-):
born Hungary, U.S.A. 1937



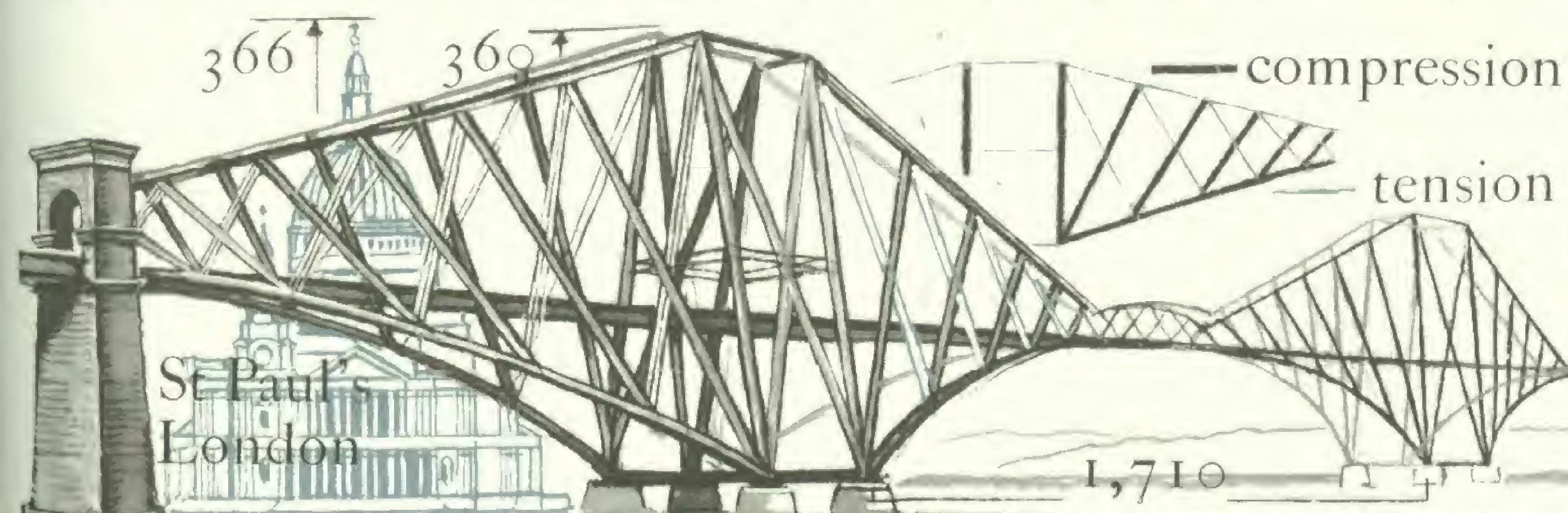
steel
frame



auditorium
insulated
by foyers

Heal & Son Store, London,
1910-14 *Smith & Brewer*

Peter Jones Store, London,
1936-39 *William Crabtree*



Royal Festival Hall, London,
1951 *Robert Hogg*
Matthew (1906-)

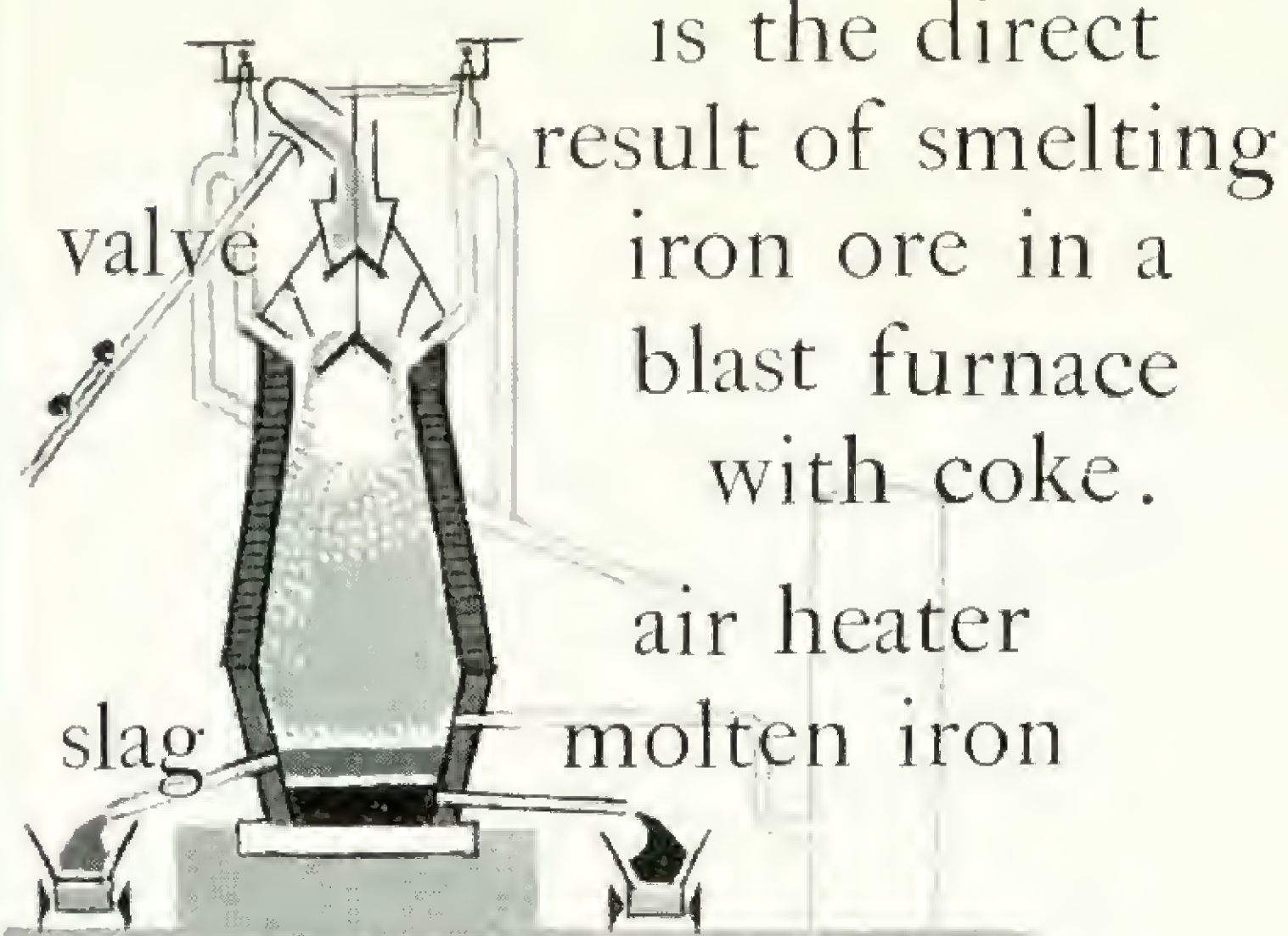
St Paul's
London

1,710

The Forth Bridge, 1882-1890 *Sir Benjamin Baker* & *Sir John Fowler*

19 TH & 20 TH CENTURIES

CAST IRON



is the direct result of smelting iron ore in a blast furnace with coke.

The liquid ore solidifies on cooling & can be given the desired shape by being poured into moulds. The process was first carried out c.1710 by *Benjamin Darby (1677-1717)*. Cast iron is brittle & reacts to bending stress. Used primarily for vertical columns

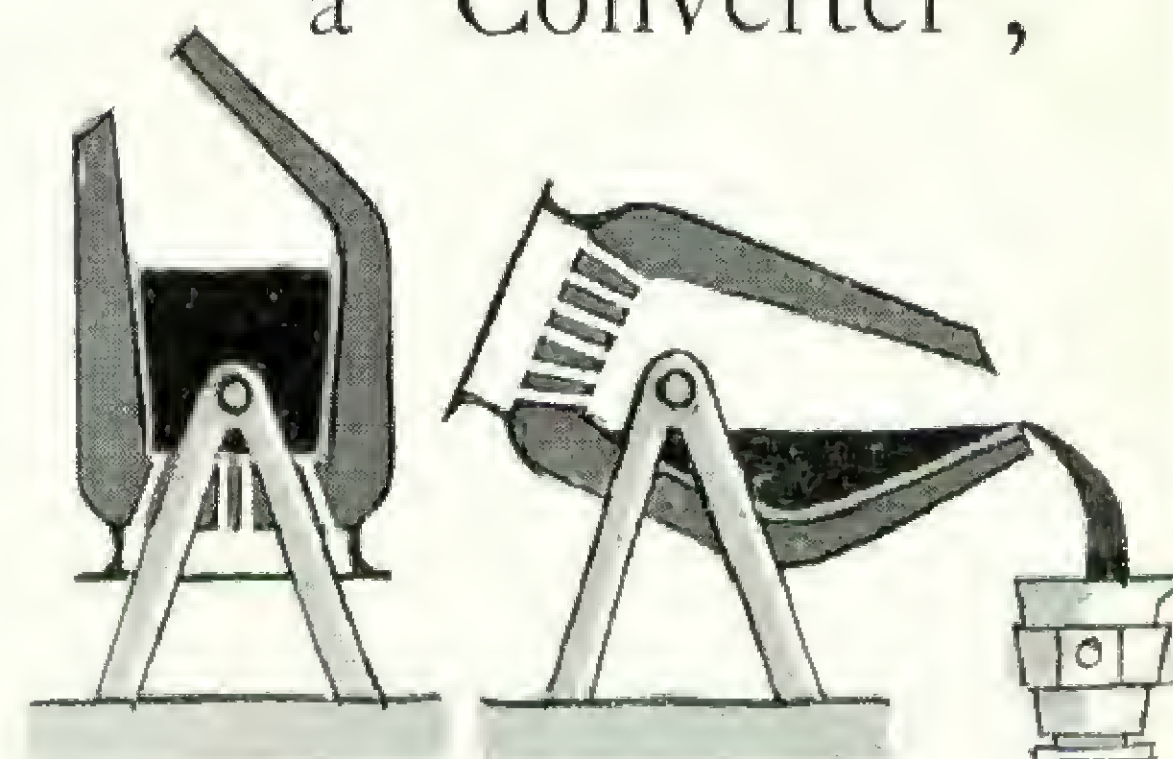
WROUGHT IRON

is obtained by oxidizing white-hot cast iron. It is puddled (purified) from an excess of carbon & impurities in a 'reverberatory' furnace, introduced by *Henry Cort c.1760s*.

Ductile and malleable, wrought-iron can be pulled out into wire or rolled into beams

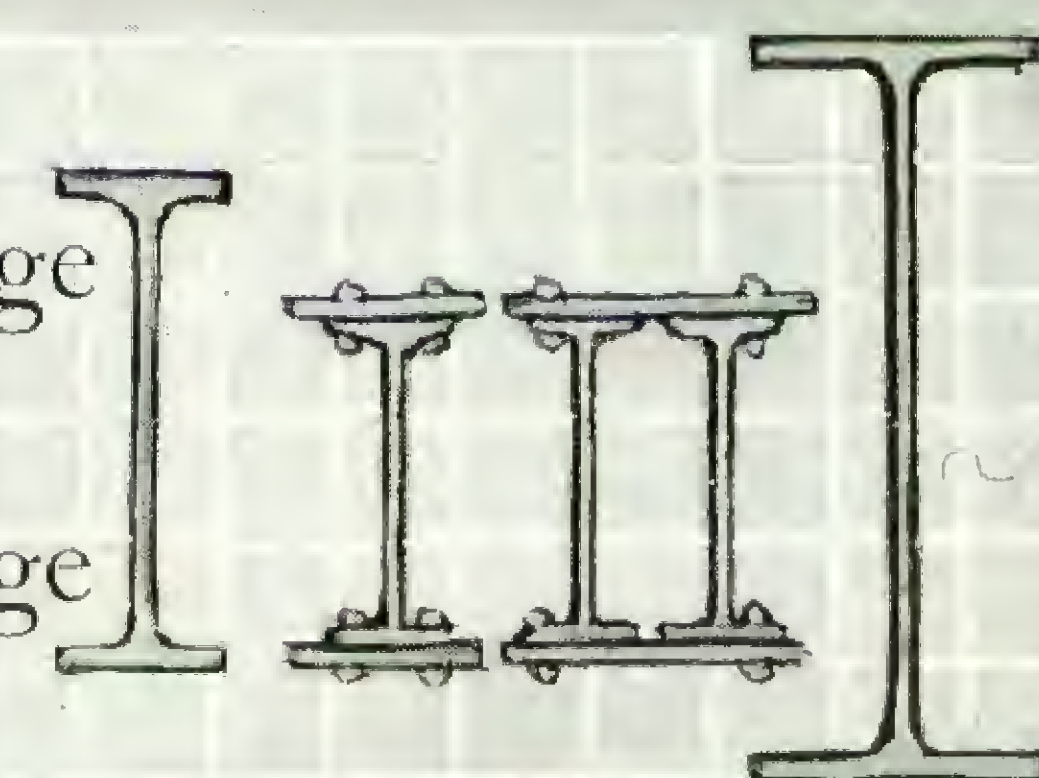
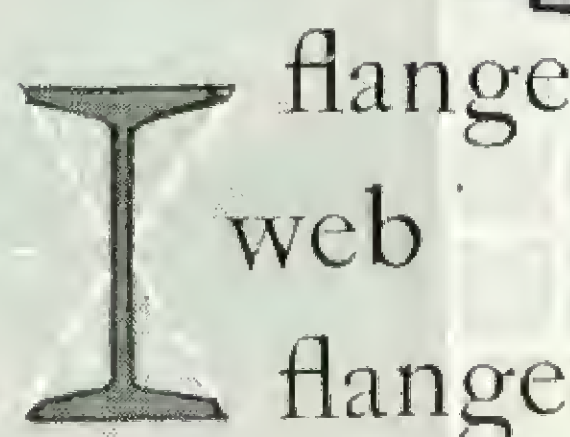
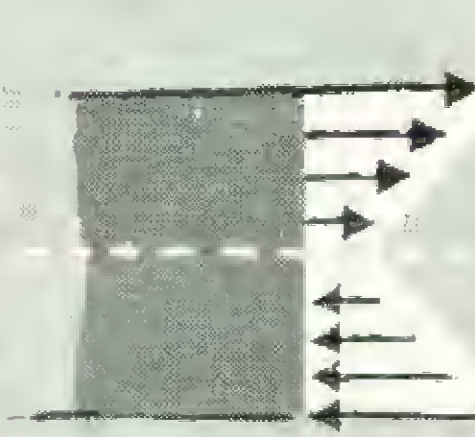
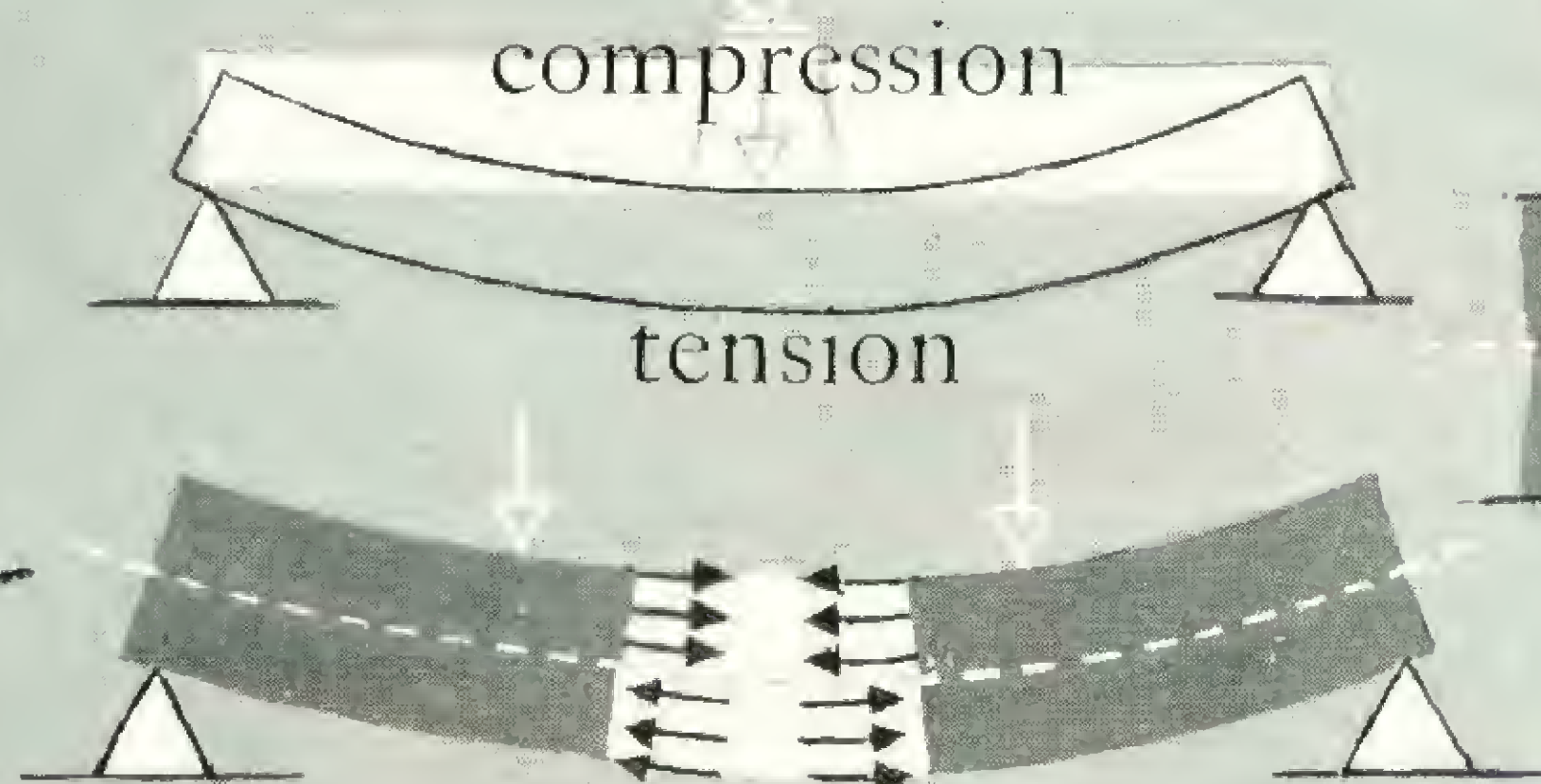
STEEL

is made from cast-iron, the carbon being burnt out by a blast of air through the molten metal in a 'Converter',



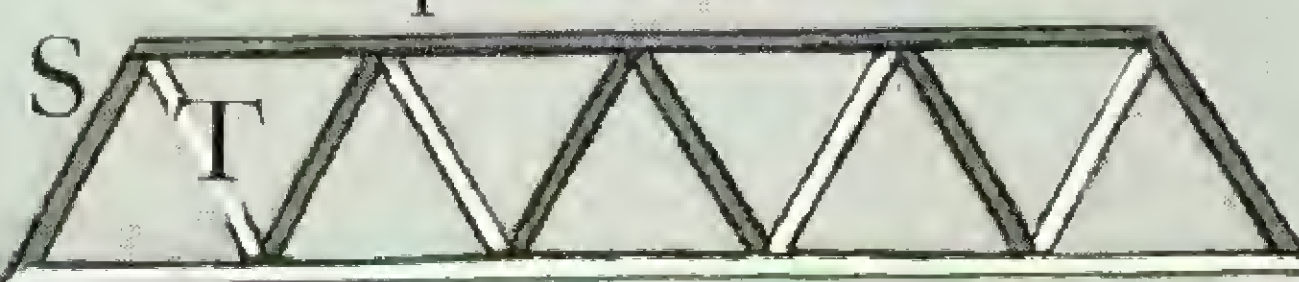
invented by *Sir Henry Bessemer* in 1856. Steel has equal strength in compression and tension

THE BEAM



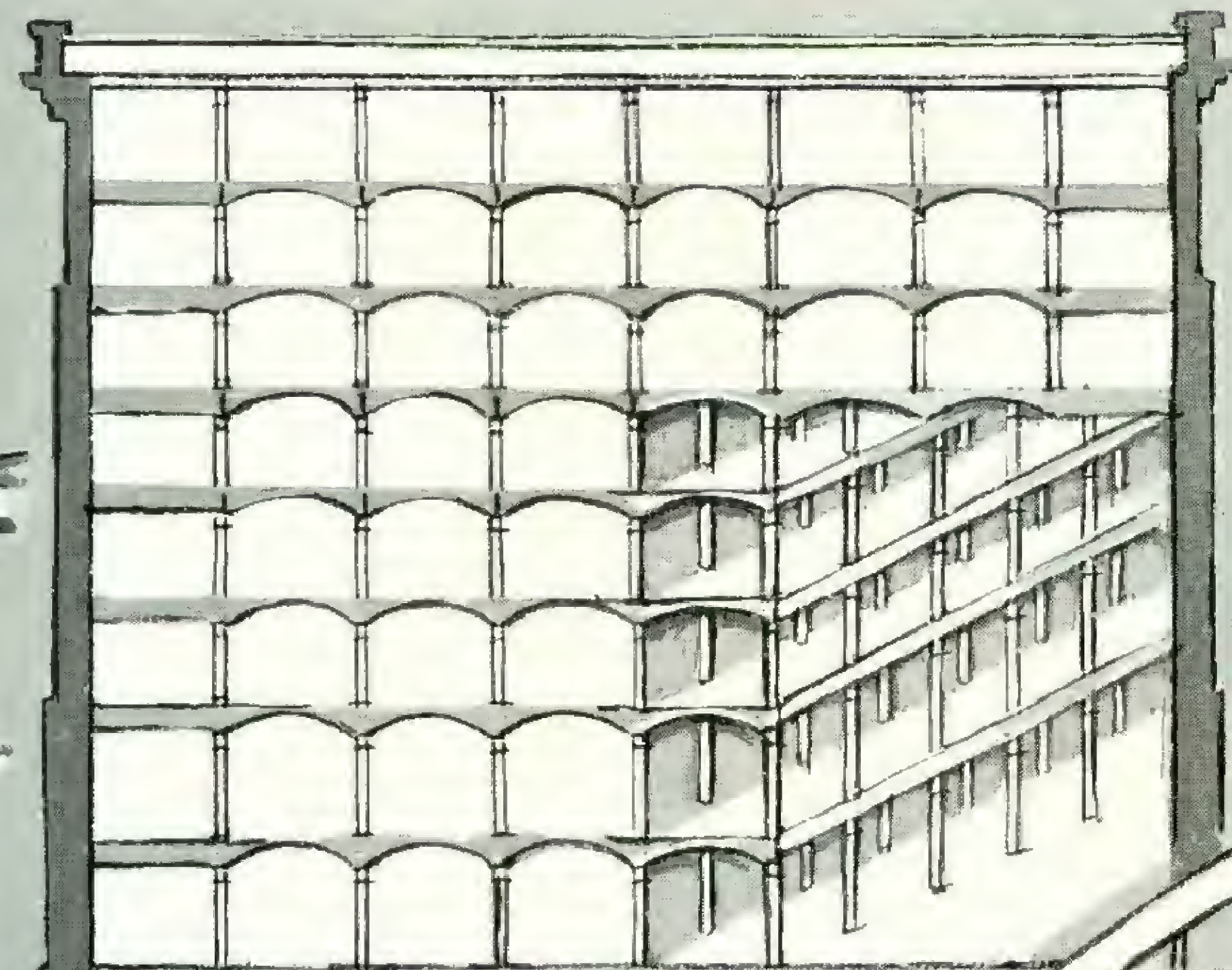
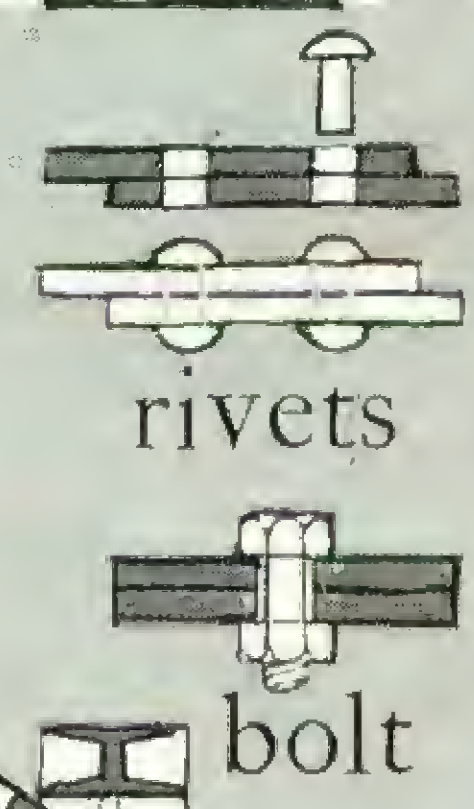
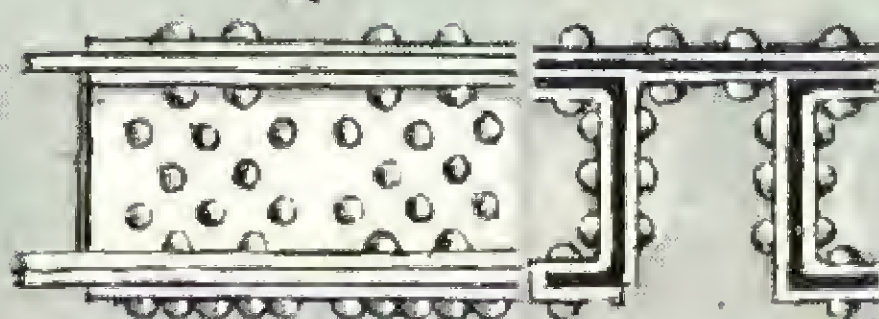
& TRUSS

compression boom



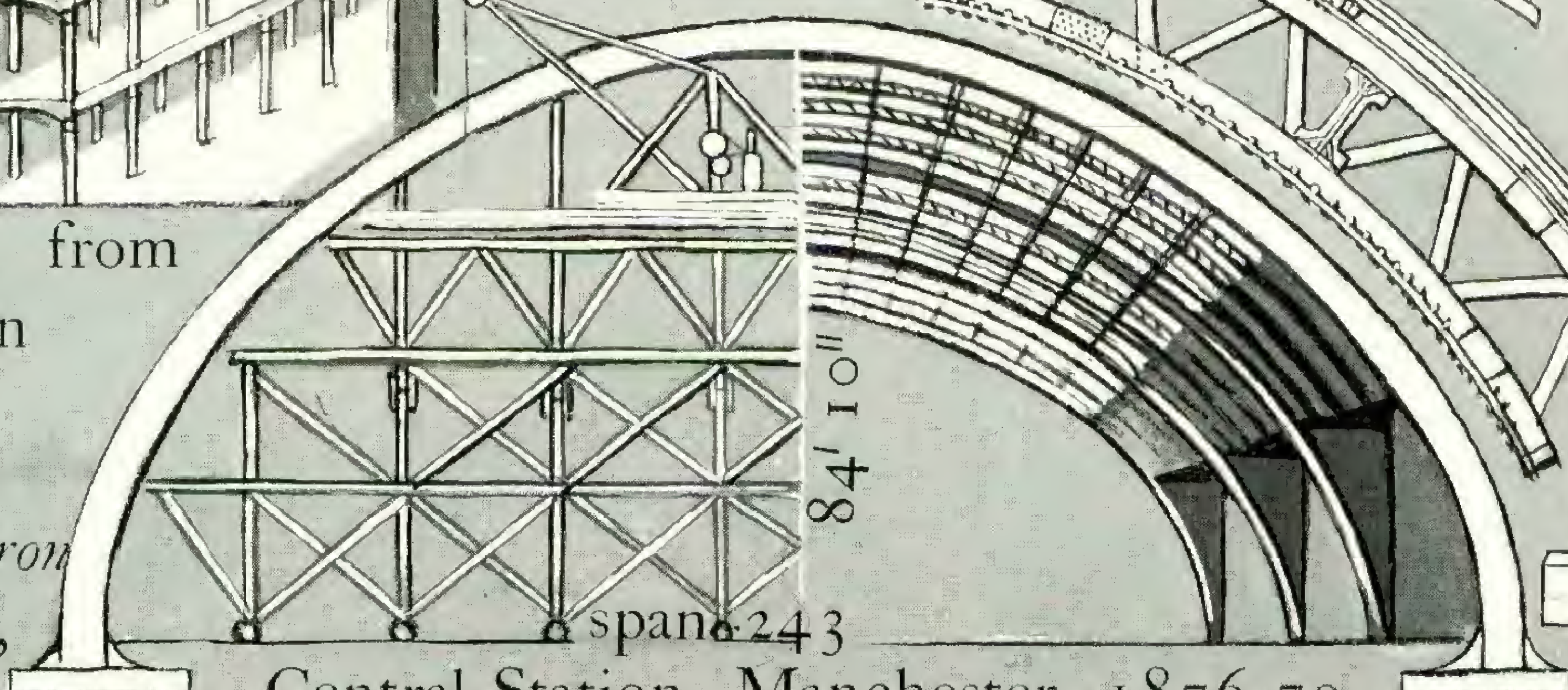
tension boom

S. / compression or strut
T. \ tension or tie



Sugar refinery, from *Sir William Fairbairn (1789-1874)*,

The Application of Cast-iron & Wrought-iron to Building Purposes, London, 1845



Central Station, Manchester, 1876-79

c.1845 Sir William Fairbairn

Cast-iron column and wrought-iron beams,

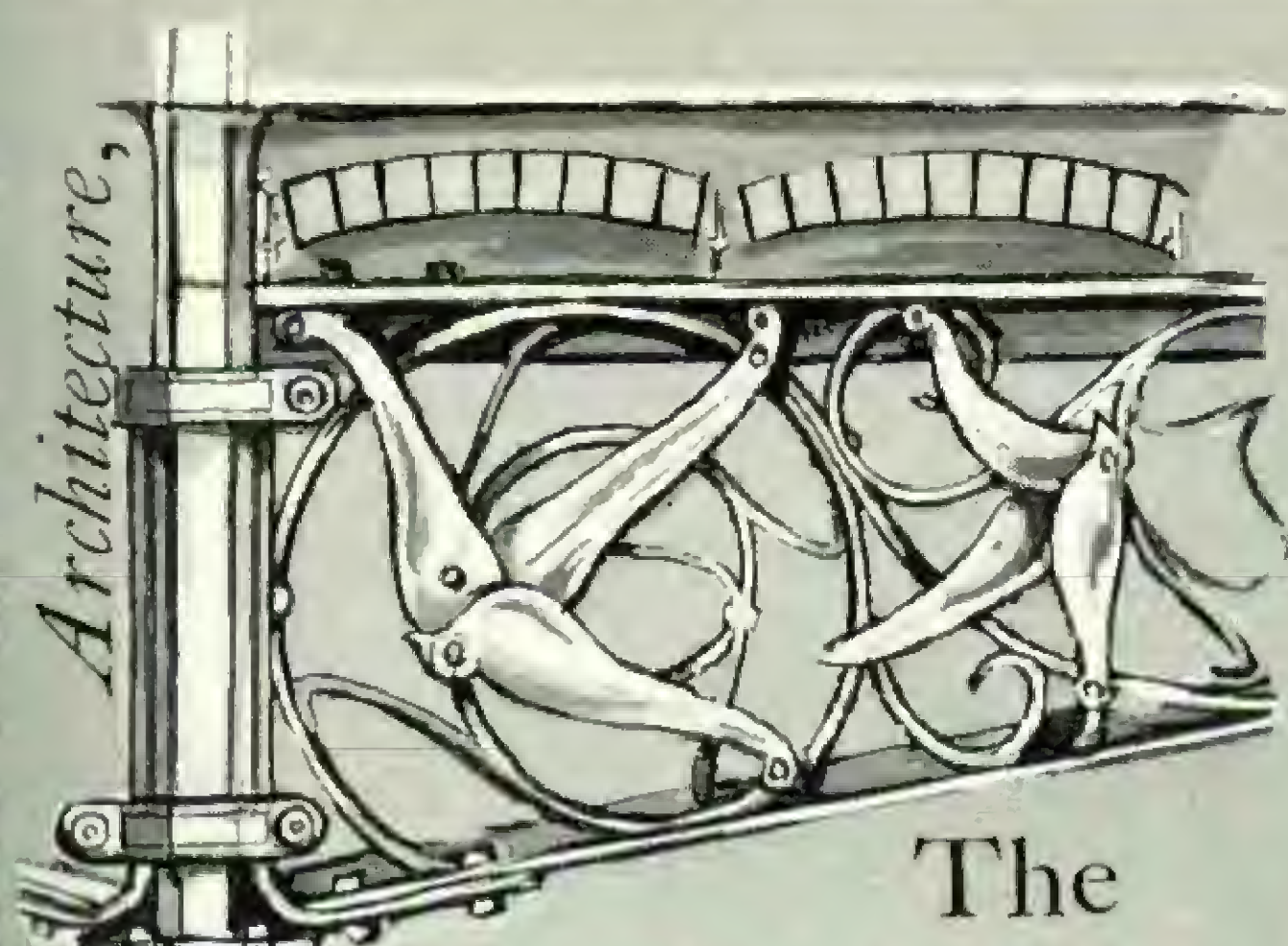
Cast-iron column, Victoria Station, London, 1861

Cast-iron column, Birkenhead, c.1876

Woodside Station, Birkenhead, c.1876

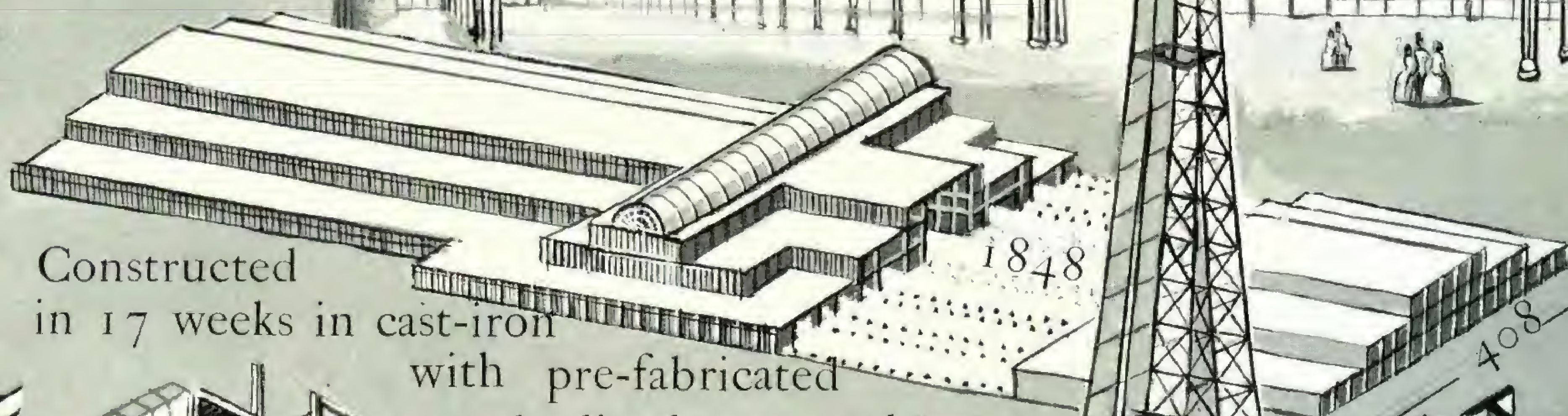
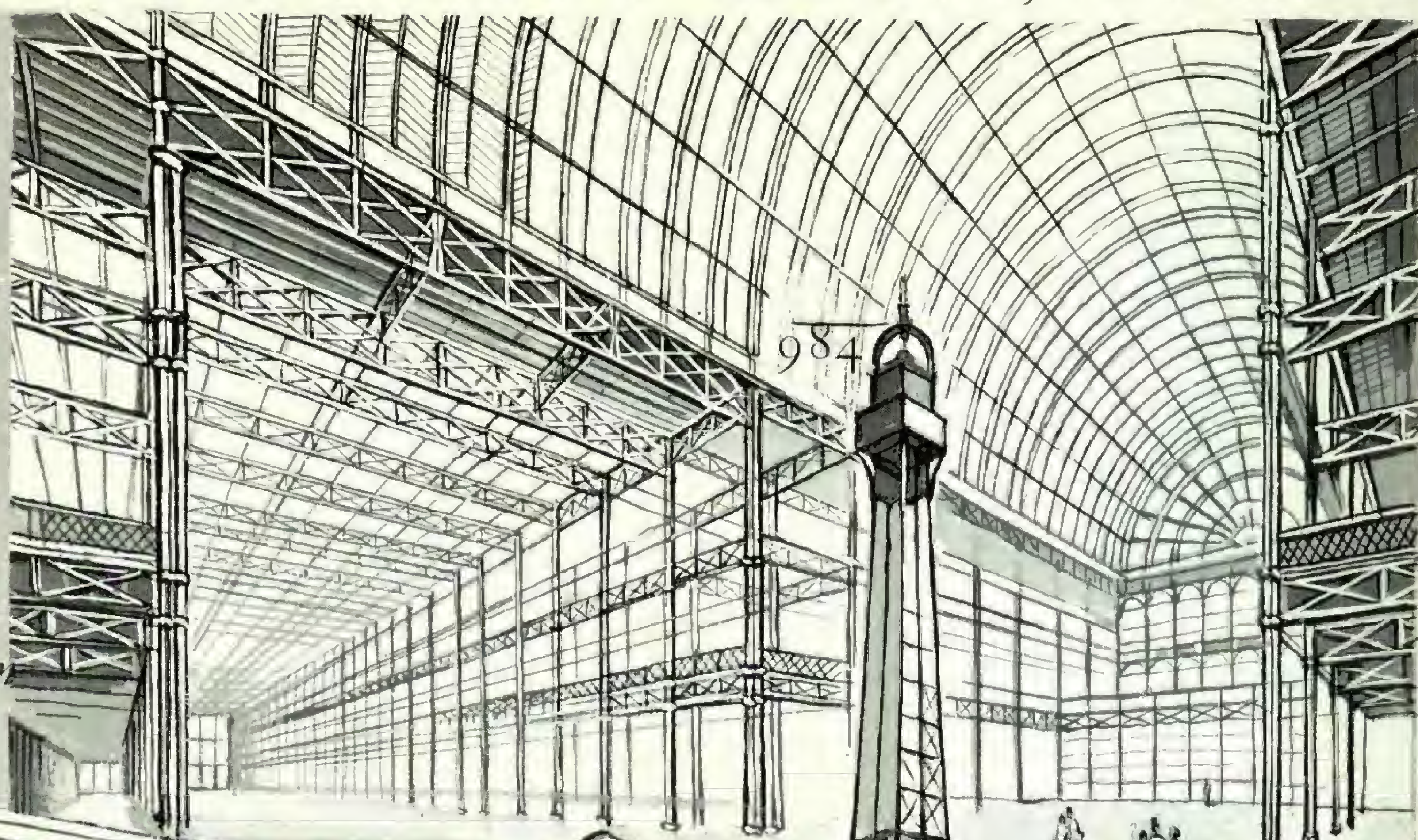
CAST IRON, WROUGHT IRON, STEEL

Design for wrought-iron column: Viollet-le-Duc (1814-79), from Lectures on Architecture,

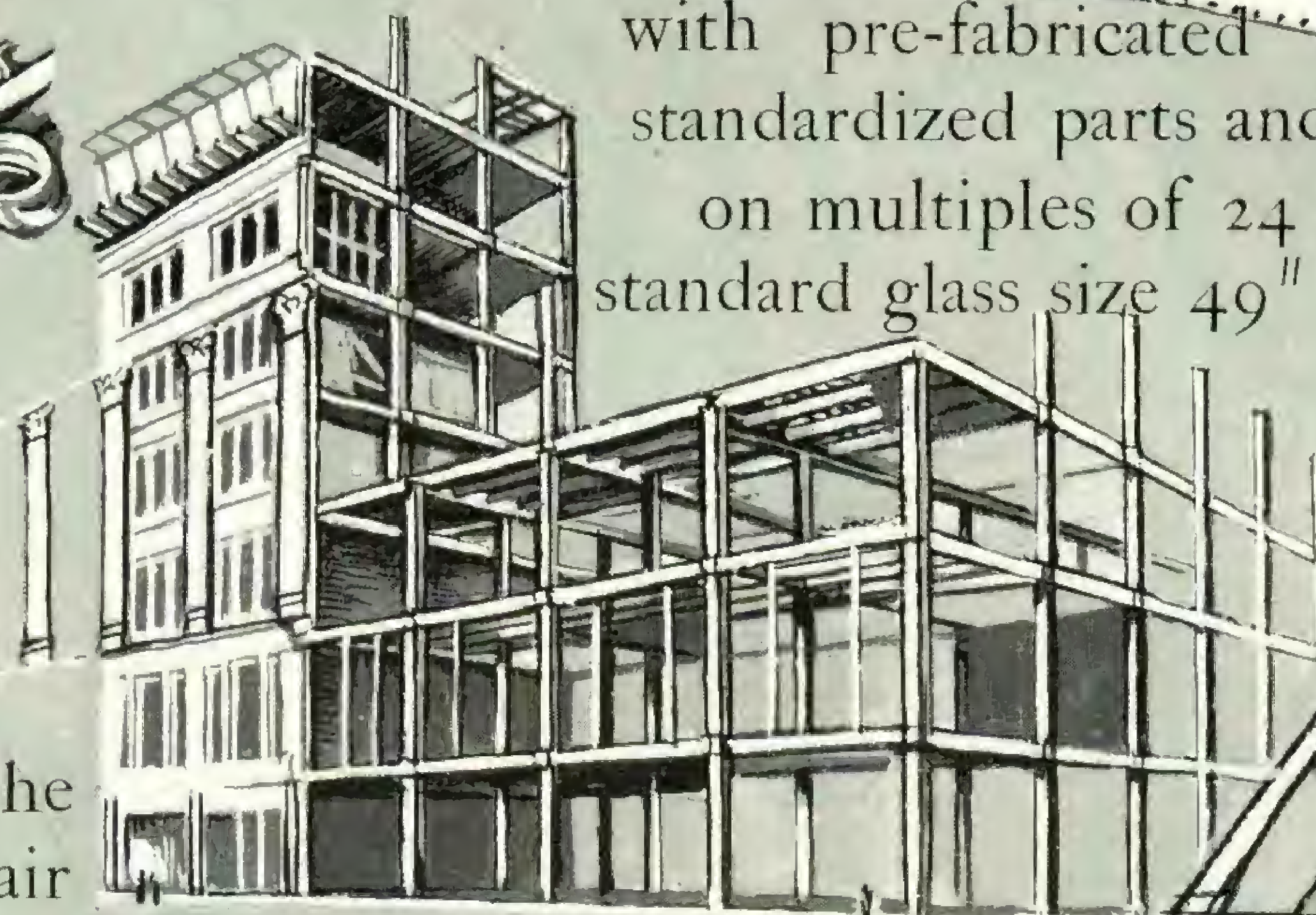


Paris, 1863-72

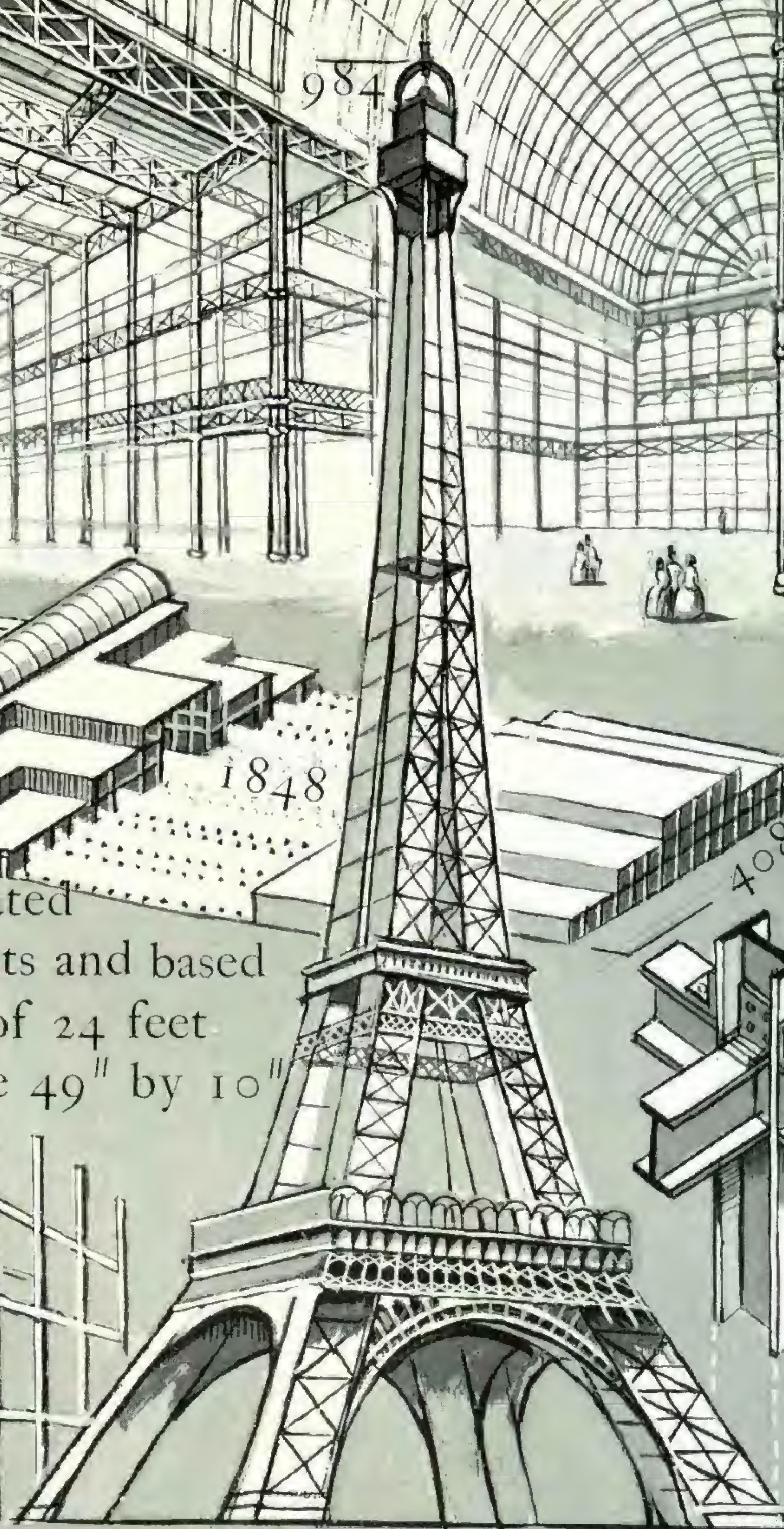
The Crystal Palace, Hyde Park, London, 1851
Sir Joseph Paxton (1803-1865)



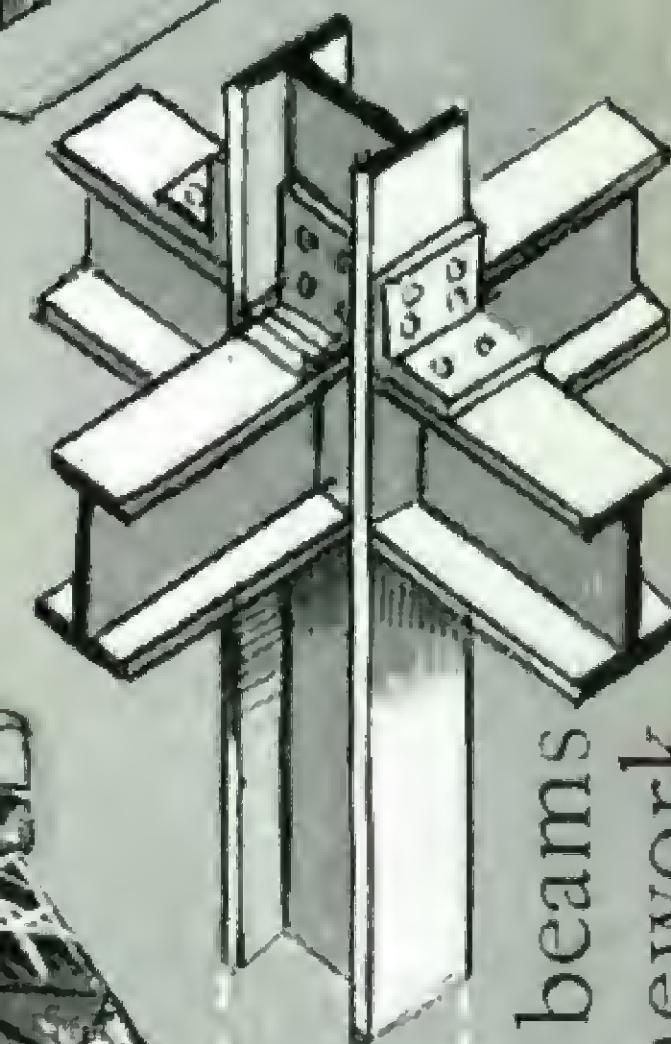
Constructed in 17 weeks in cast-iron with pre-fabricated standardized parts and based on multiples of 24 feet standard glass size 49" by 10"



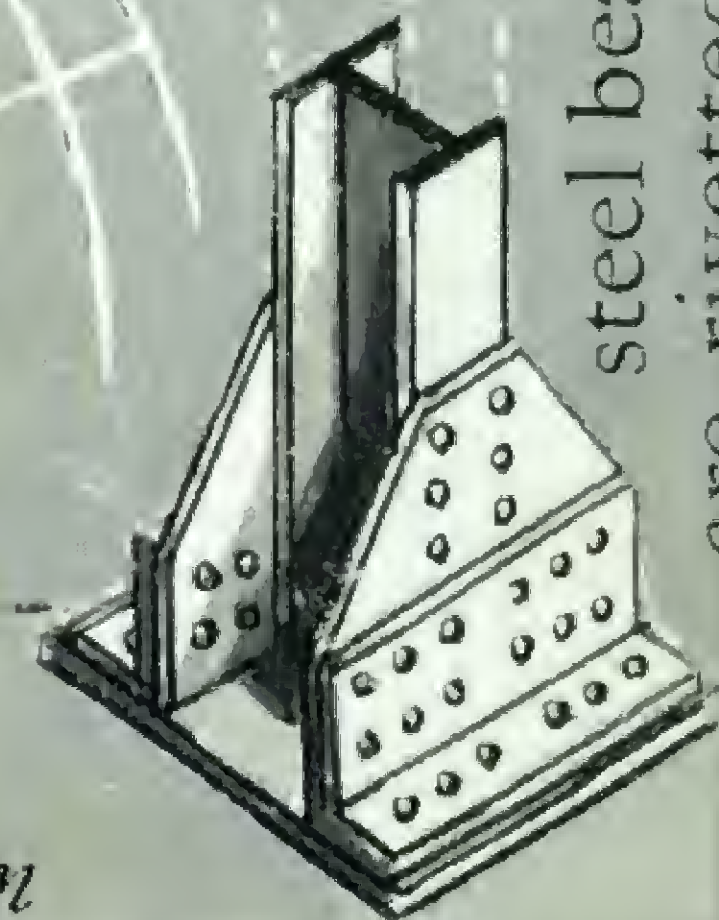
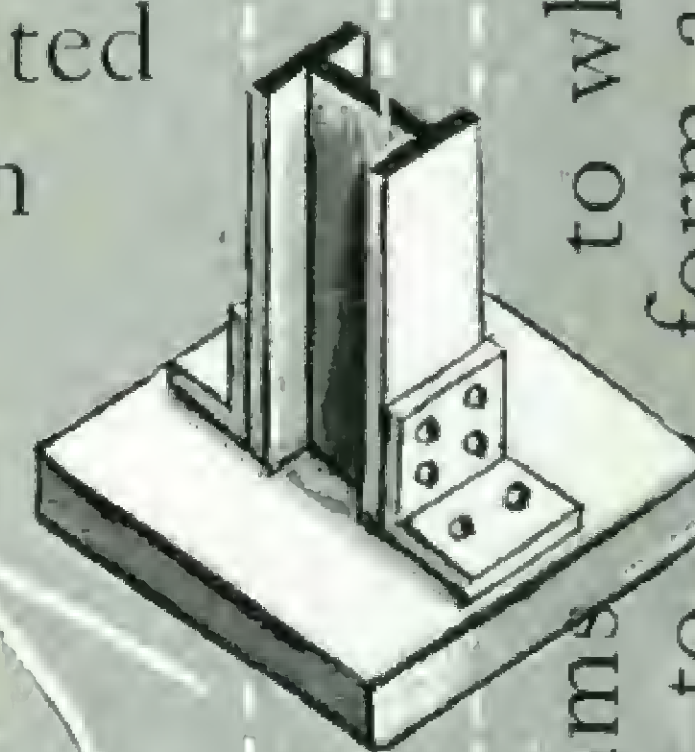
The Fair Building, Chicago, U.S.A., 1891
William Le Baron Jenny (1832-1907)



The Eiffel Tower, Paris, 1887-89. Constructed of wrought-iron
Gustave Eiffel (1832-1923)



to which cross beams are rivetted to form a rigid framework



steel beams are rivetted to

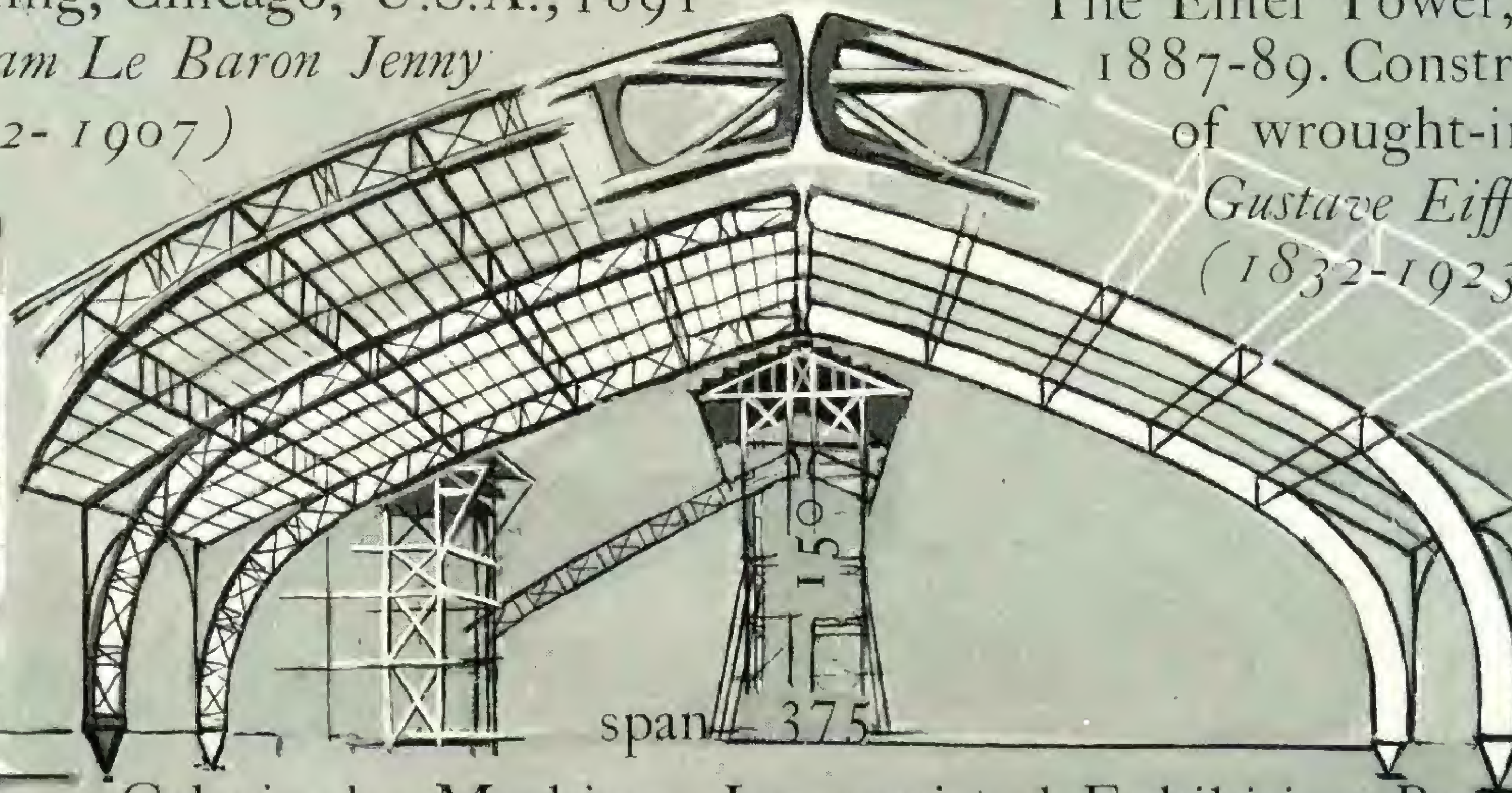
Art Nouveau: cast-iron structure, Brussels, 1893

Victor Horta (1861-1947)

Brussels, 1893



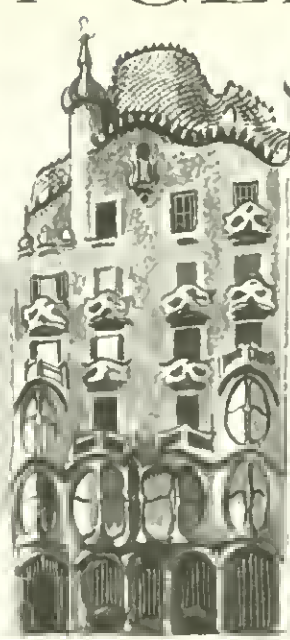
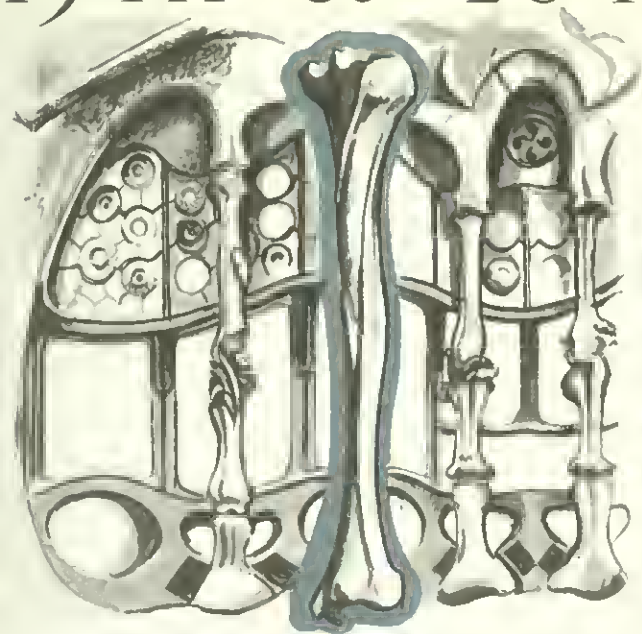
hinge base



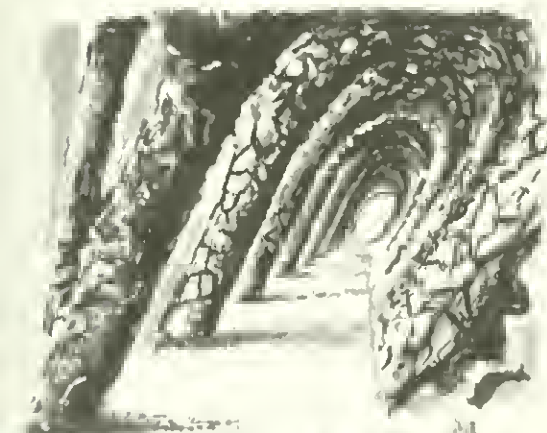
Galerie des Machines, International Exhibition, Paris, 1889: three-hinged steel arch
Dutert, engineer Cottamin

span 375

19TH & 20TH CENTURIES

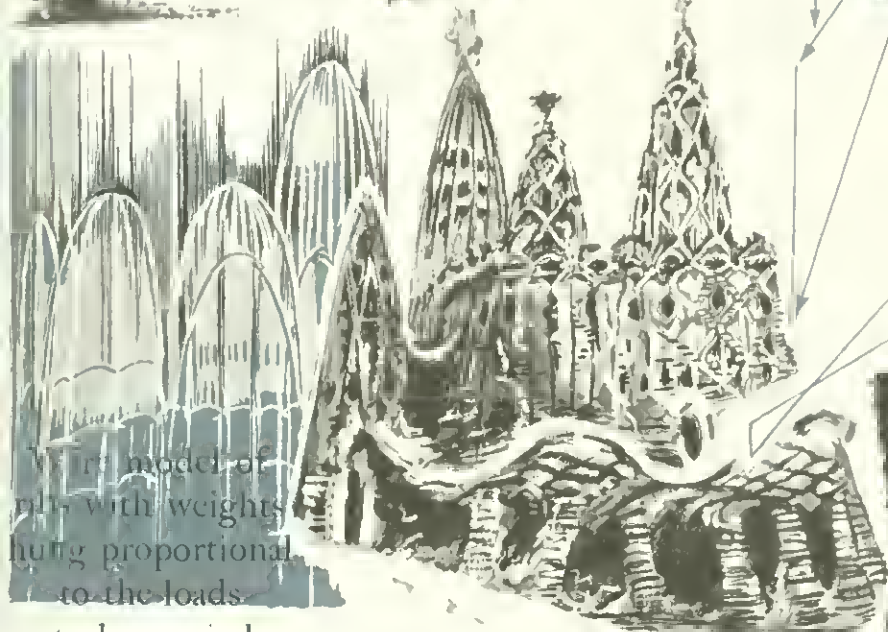
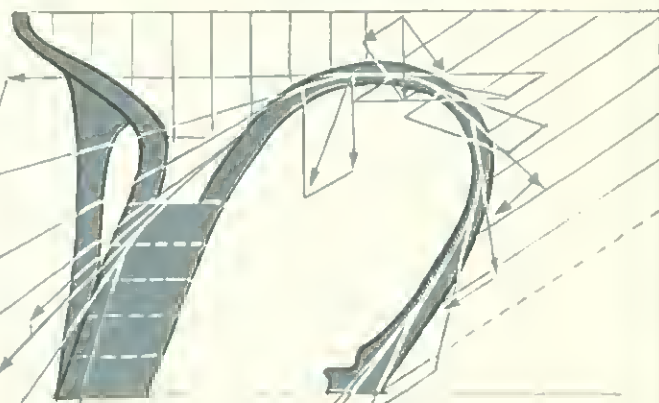


Casa Batlló ('House of the bones'), Barcelona, 1903-07 *Gaudí*



Parc Güell,
Barcelona,
1900-14
Gaudí

tilted
helicoid
columns



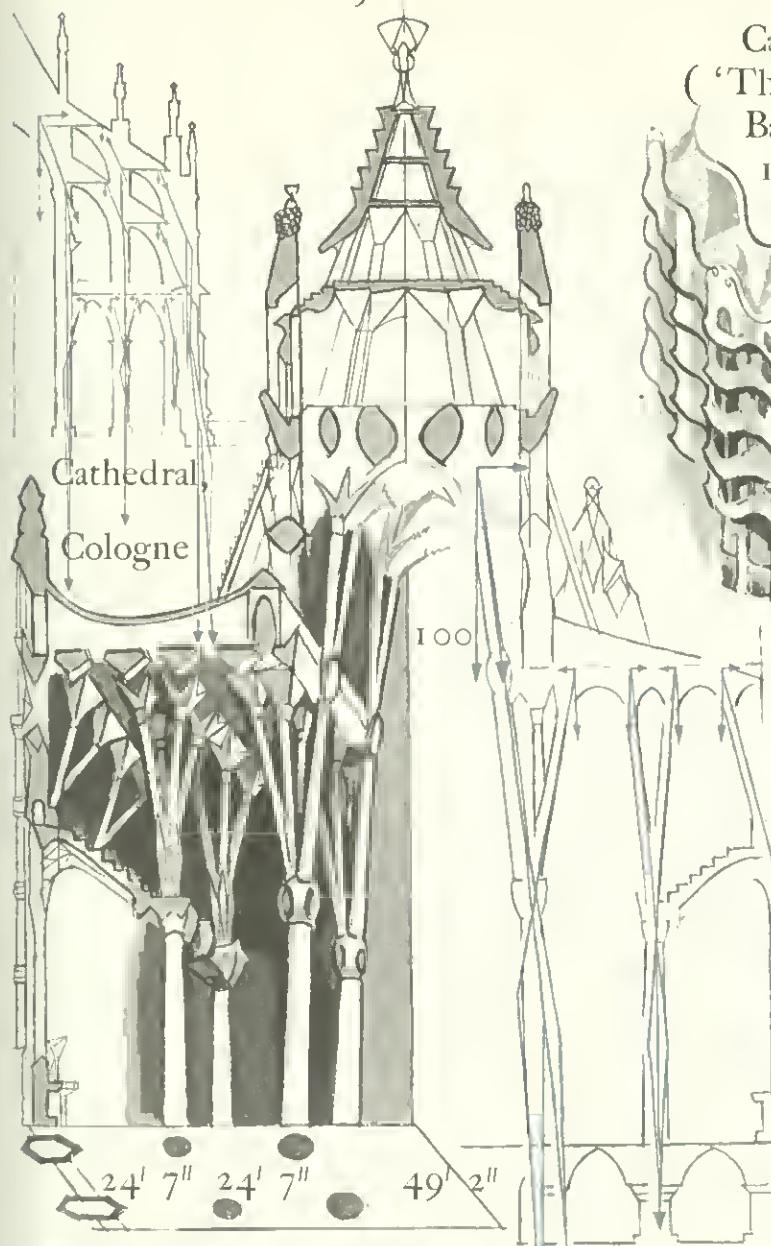
Wren model of
rubbish with weights
hung proportional
to the loads
to be carried



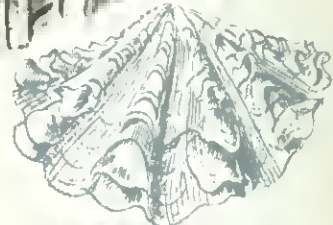
Project for Güell Colony chapel, nr Barcelona 1898-1914 *Gaudí*

Antoni Gaudí (1852-1926): born Reus, near Tarragona; worked & died in Barcelona. 'Gaudí'

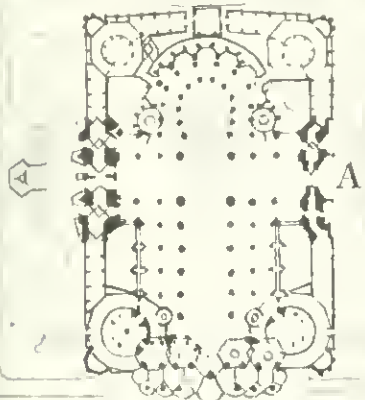
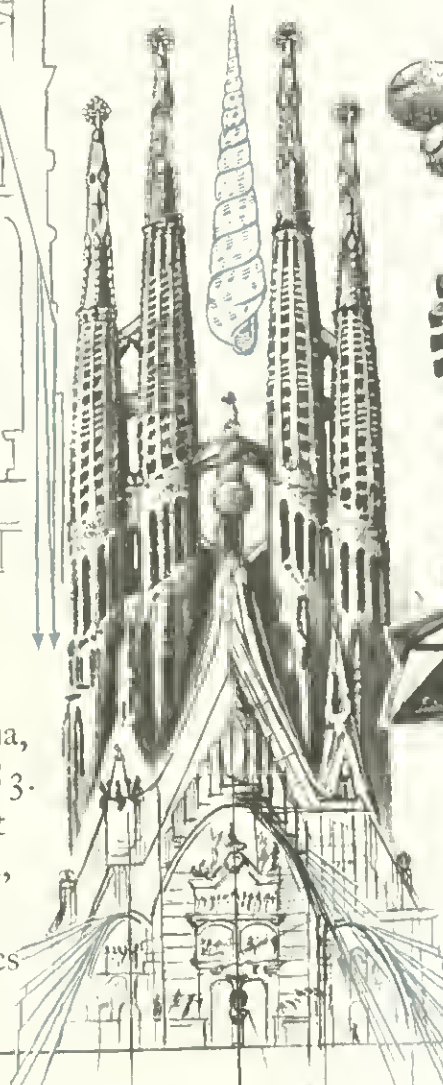
SPAIN, MODERNISMO, GAUDÍ



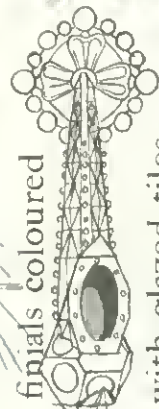
Casa Milá
('The Quarry'),
Barcelona,
1905-10
Gaudí



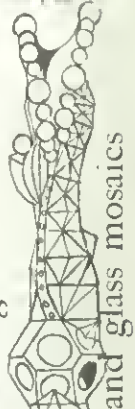
Sagrada Família,
Barcelona, 1883.
Unfinished at
Gaudí's death,
1926;
work continues



A. transept, 1913-26



with glazed tiles



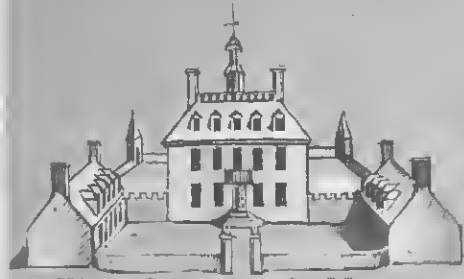
is the constructor of 1900, the professional builder in stone, iron and brick' *Le Corbusier*

19TH & 20TH CENTURIES

Colonial or Georgian period: The Revolution
influence of *Wren, Gibbs, Chambers & the Palladians*
1775-1783

Federal Period

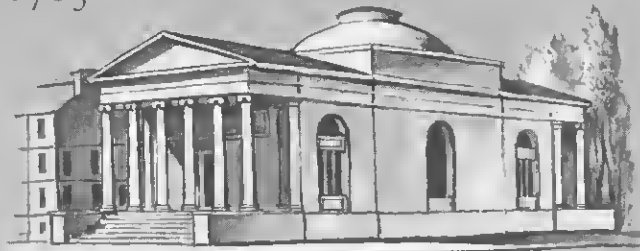
Greek & Gothic



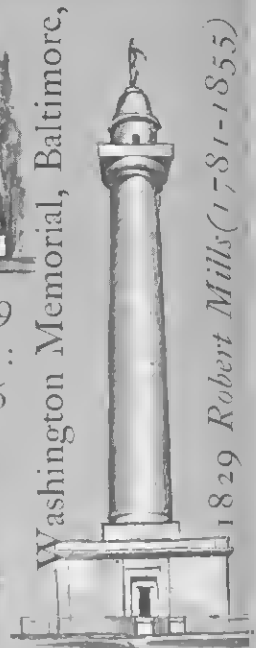
The Governor's House,
Virginia, 1705 (rebuilt 1932)



St Michael,
Charleston,
South Carolina,



The Bank of Philadelphia, 1798-99
Benjamin Latrobe (1764-1820):
born England; U.S.A. 1796



Washington Memorial, Baltimore,

1829 *Robert Mills* (1781-1855)



Westover, Virginia, c.1730 1761



State House, Boston, 1793-98
Charles Bulfinch (1763-1844)



Redwood Library, Newport, Rhode
Island, 1750 *Peter Harrison* (1716-75):
born England; U.S.A. 1740



Temple, Nîmes



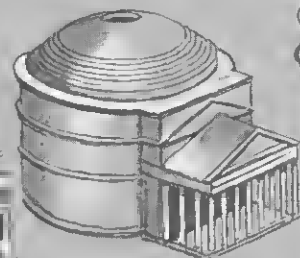
State House, Richmond,
Virginia, 1785-96 *Jefferson*



First
design



Trinity Church,
New York, 1846
Richard Upjohn
(1802-1878)



the Pantheon,
Rome



University of Virginia, Charlottesville, 1822-26



University of Virginia, Charlottesville
1770-1809

Thomas Jefferson (1743-1820); studied Roman buildings in Europe 1784-89

revivals

Civil War 1861-1865

The Chicago School 1883- (pp.168-9)



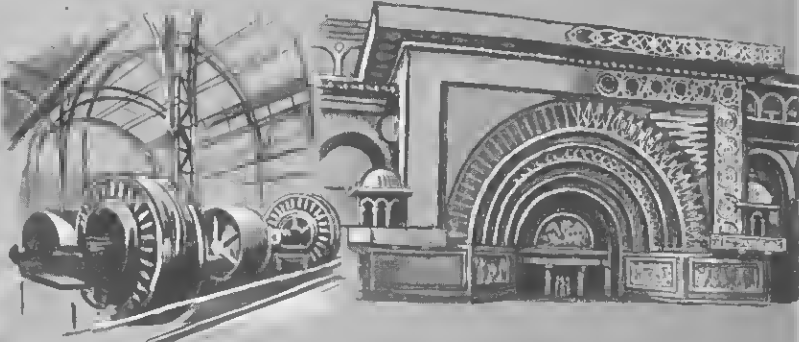
Romanesque,
Salamanca



Crane Library, Quincy,
Massachusetts, 1883

Exchange, Philadelphia
1832-4 *William Strickland*
(1788-1845),
pupil of Latrobe

Trinity Church, Boston, 1872-77
Henry Hobson Richardson (1838-1886): studied in Paris



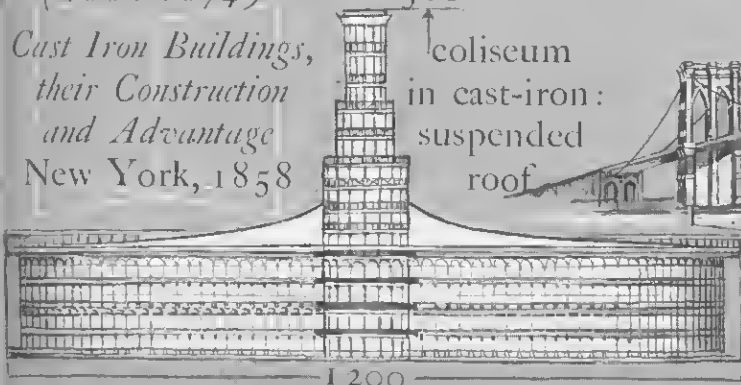
The Capitol, Washington:
central block, 1792-1828,
William Thornton (1759-1828) & others.
Wings & dome (cast-iron), 1851-65
Thomas Ustick Walter (1804-1887)

Transportation Building, Chicago Exposition,
1893 *Louis H. Sullivan* (1856-1924):
Paris 1874 *Frank Lloyd Wright* worked
with Sullivan 1888-93

James Bogardus
(1800-1874)

*Cast Iron Buildings,
their Construction
and Advantage*
New York, 1858

300
coliseum
in cast-iron:
suspended
roof

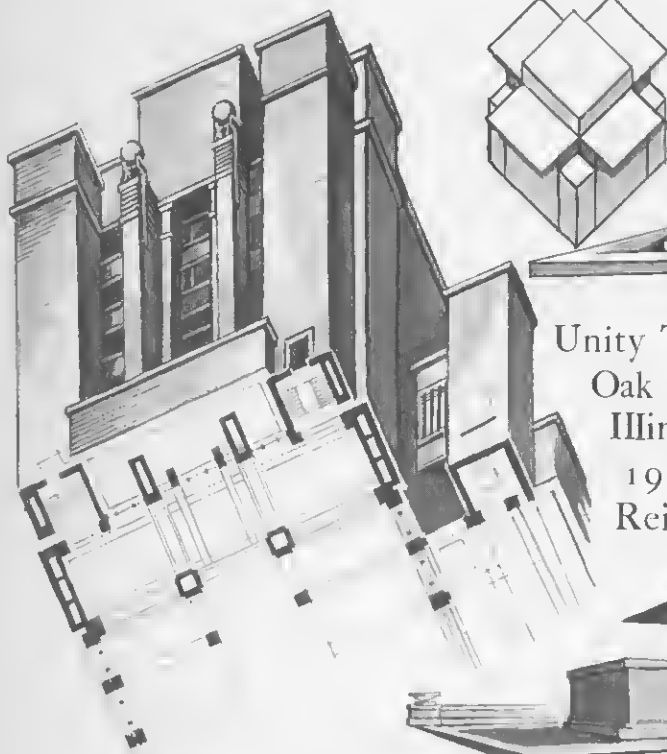


Project, New York World's Fair, 1853

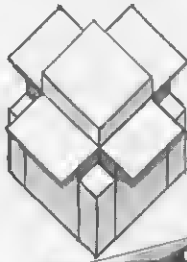


Brooklyn Bridge, 1869-1883 *John Roebling*
(1806-69) & *W. A. Roebling* (1837-1926)

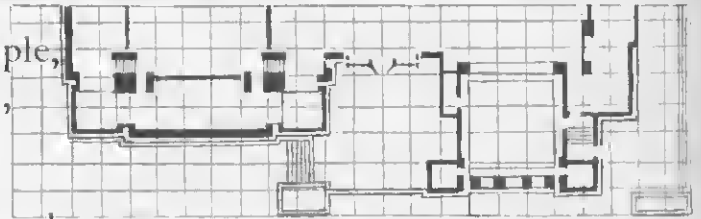
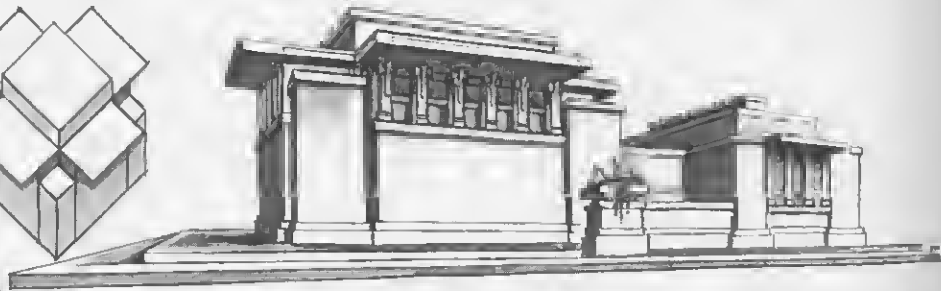
19TH & 20TH CENTURIES



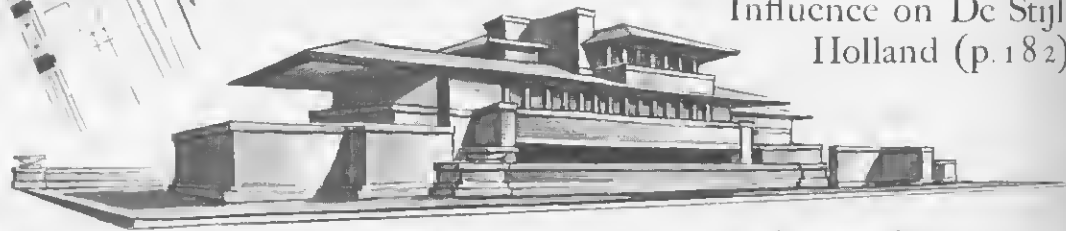
Larkin Administration Building,
Buffalo, 1904. Brick



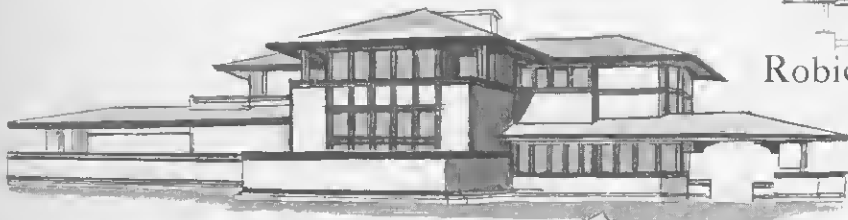
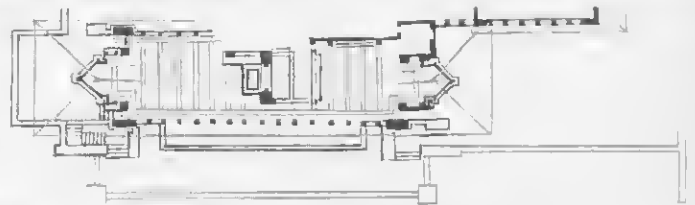
Unity Temple,
Oak Park,
Illinois,
1906.
Reinforced concrete



Influence on De Stijl,
Holland (p.182)



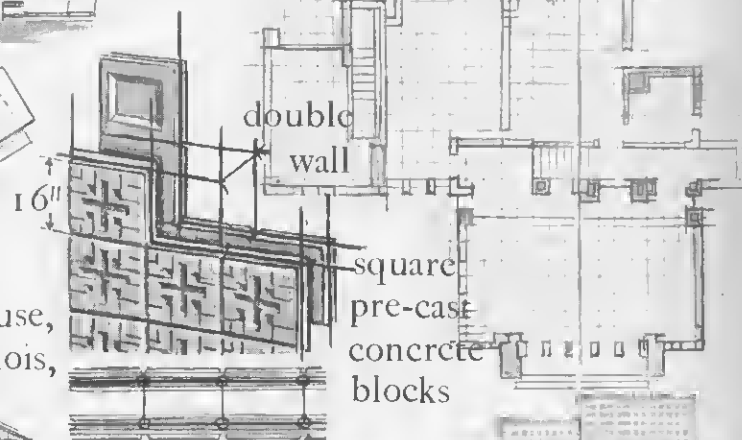
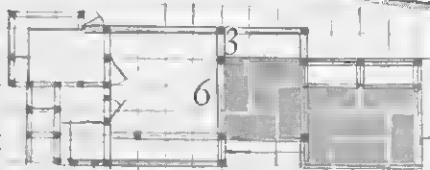
Robie House, Chicago, Illinois, 1909



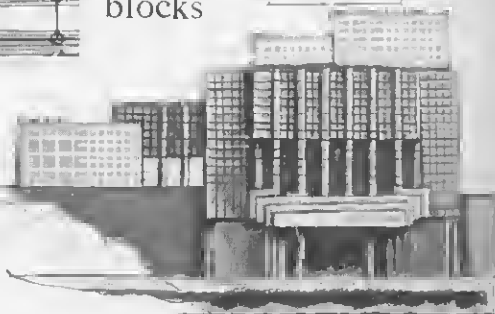
Willetts House,
Highland Park, Illinois,
1902



Japanese house
based on the
standardized shape
of mats 6 by 3 feet

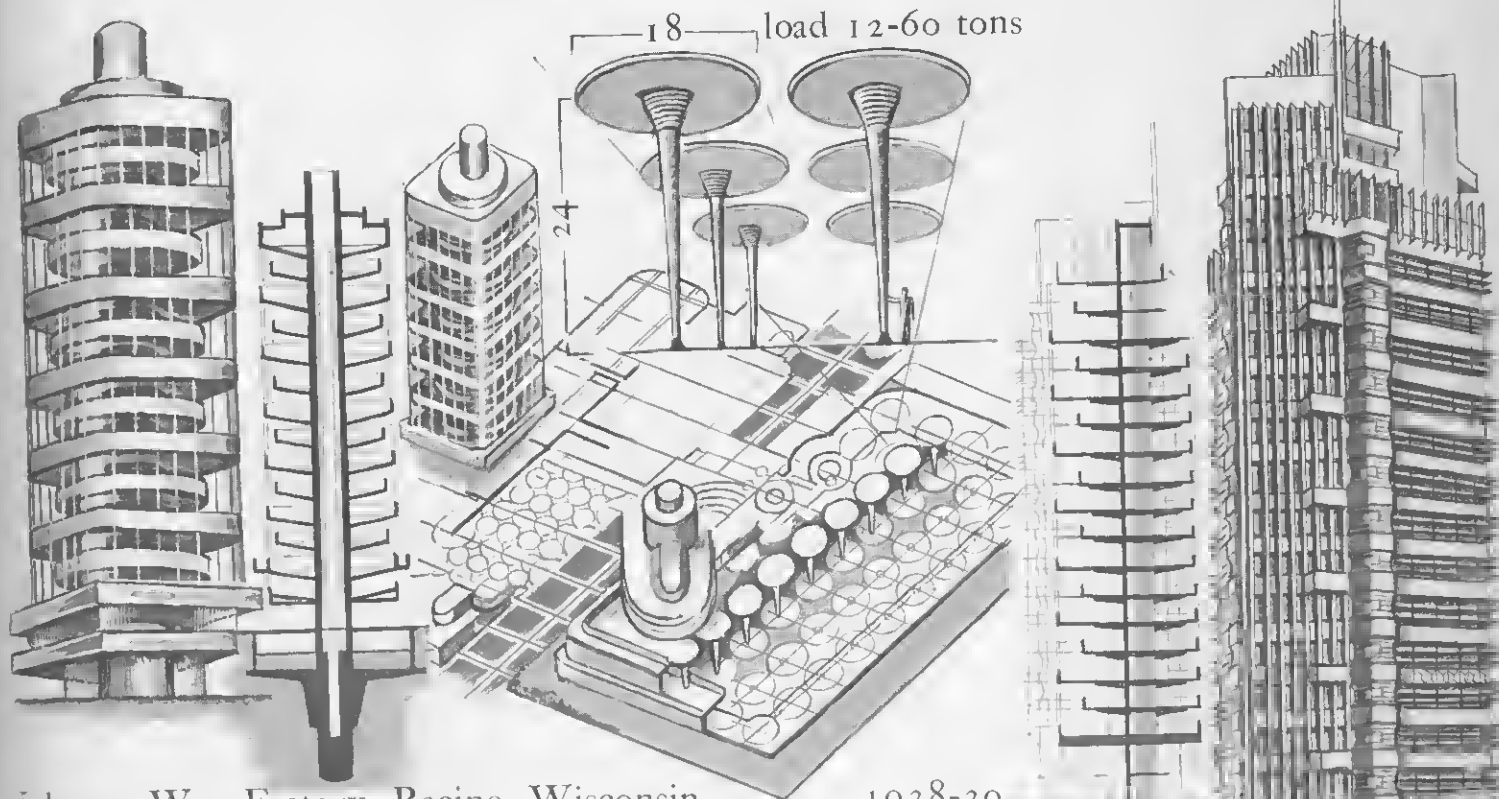


Millard
House,
Pasadena,
California,
1923



Frank Lloyd Wright (1867-1959), born Wisconsin, worked with Louis Sullivan 1888-93.

U. S. A., FRANK LLOYD WRIGHT



Johnson Wax Factory, Racine, Wisconsin,

1938-39



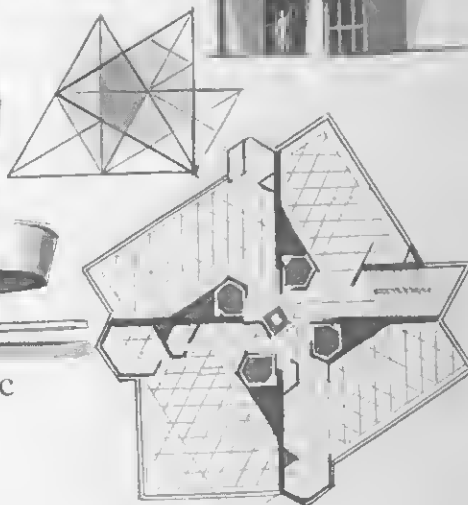
Guggenheim
Museum,
New York,

designed 1943-46, built 1956-59. Reinforced concrete

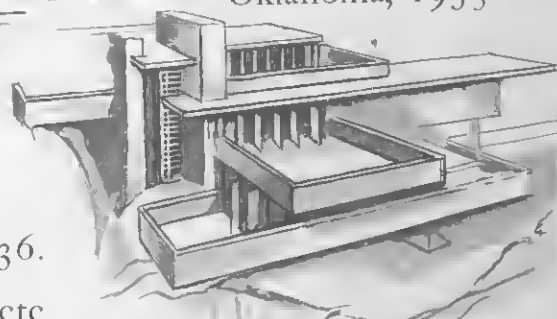


Falling Water,
Bear Run,
Pennsylvania, 1936.

Reinforced concrete

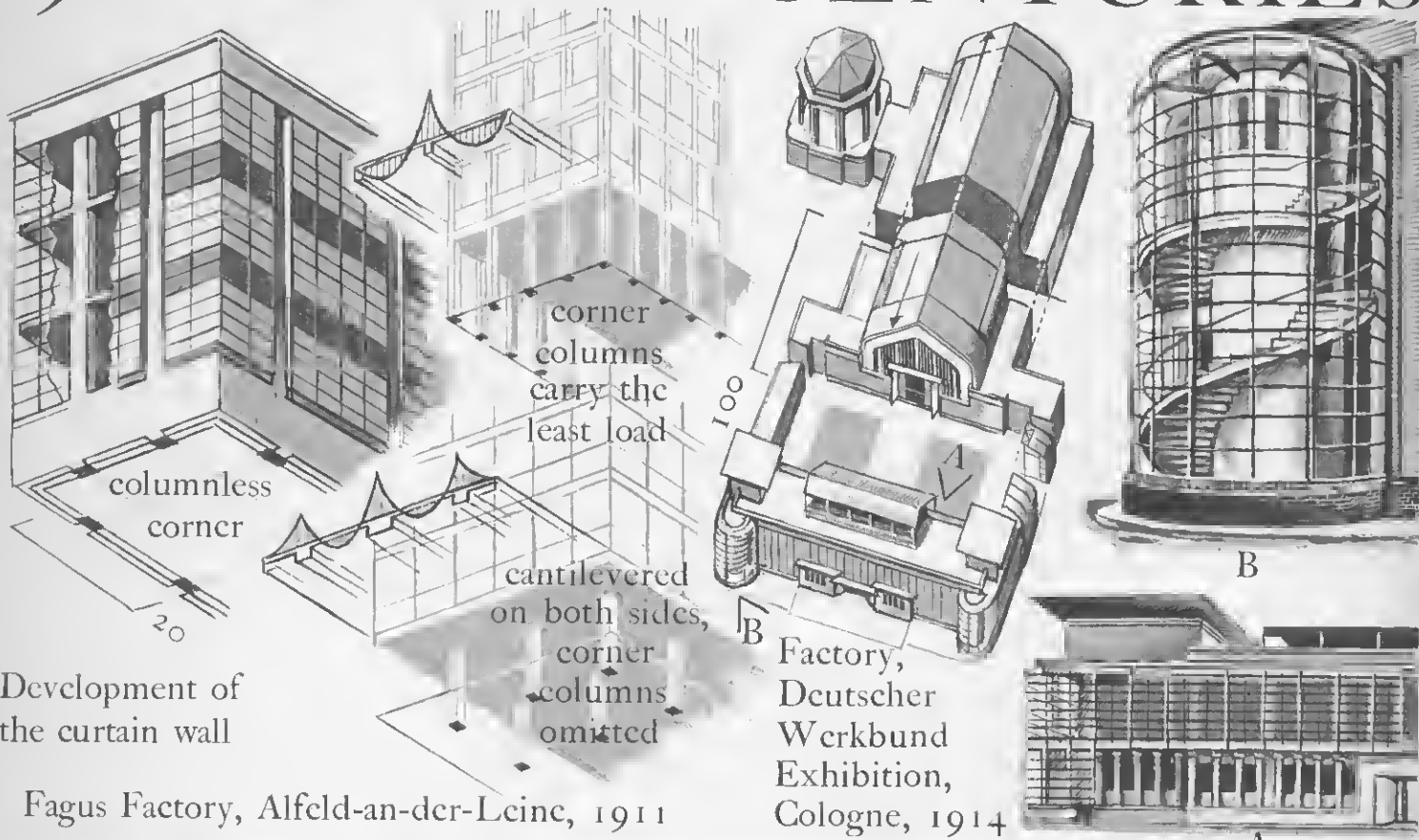


Price Tower, Bartlesville,
Oklahoma, 1953



He innovated designs for an 'organic' architecture, kaleidoscopic in its variety

19 TH & 20 TH CENTURIES

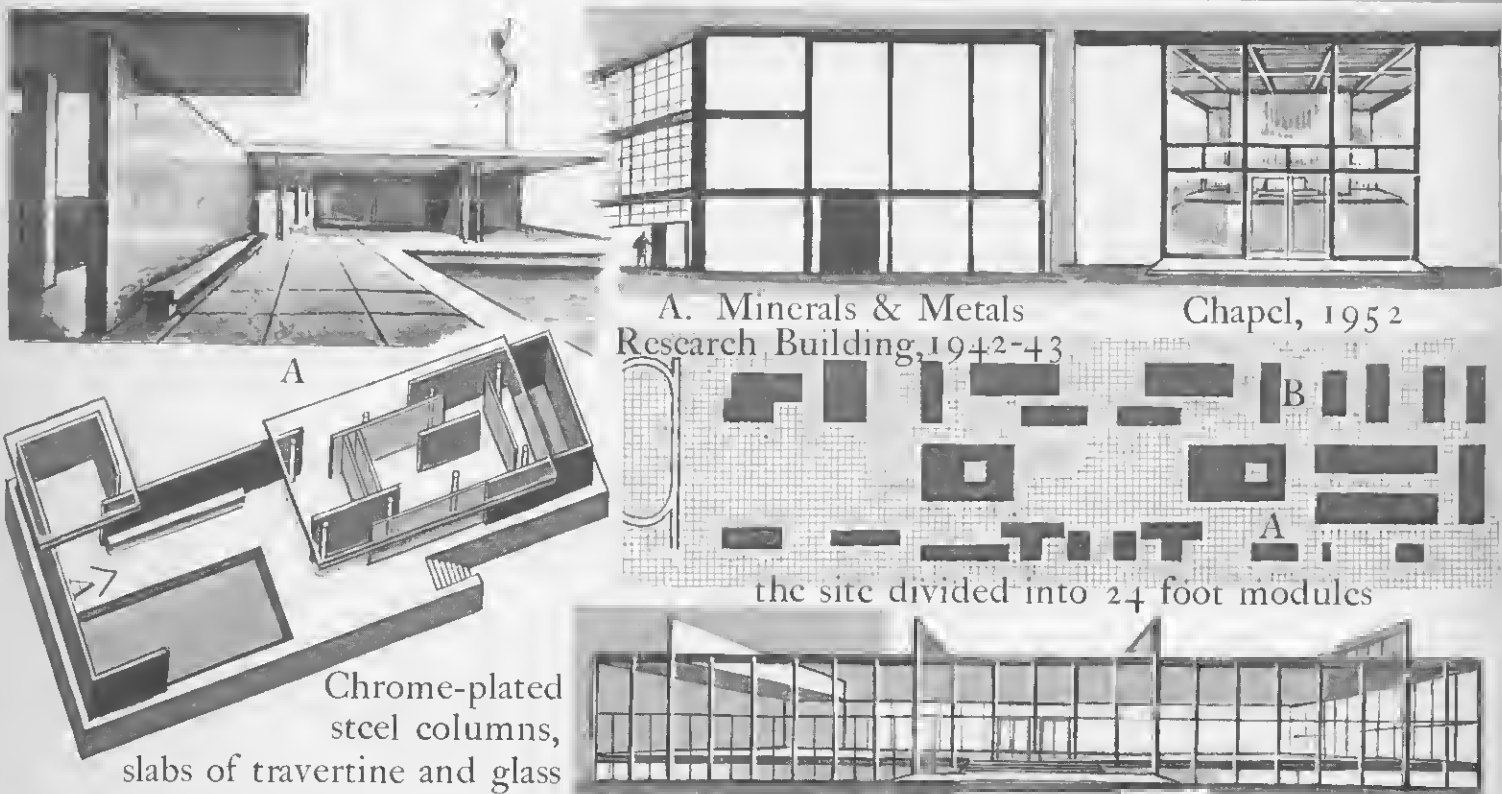


Development of
the curtain wall

Fagus Factory, Alfeld-an-der-Leine, 1911

Factory,
Deutscher
Werkbund
Exhibition,
Cologne, 1914

Walter Gropius (1883-): assistant to Behrens, 1907-11 (p.173); director of the Bauhaus,

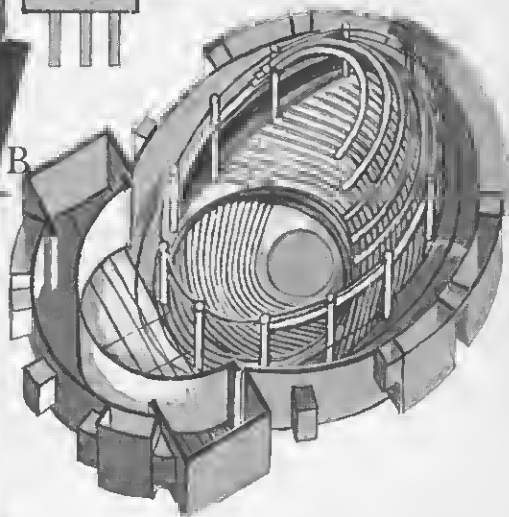
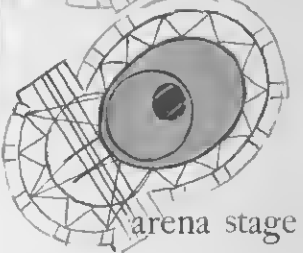
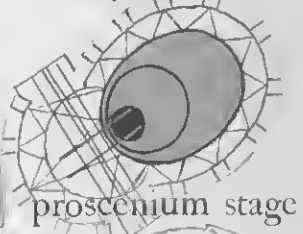
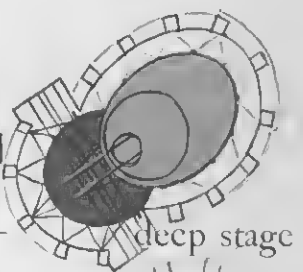
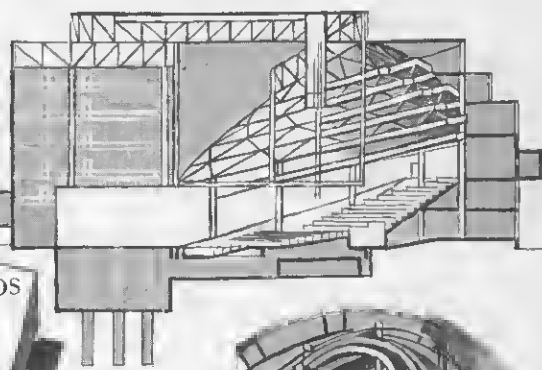
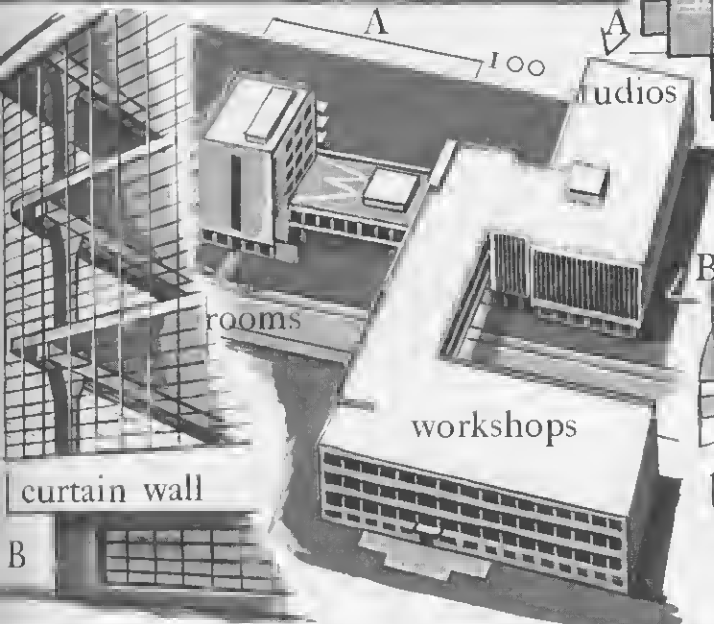
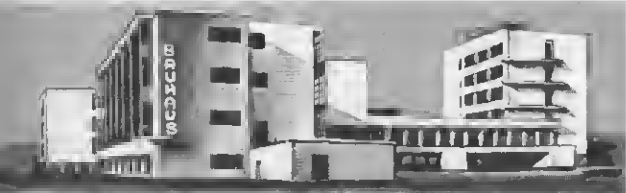


German Pavilion, International
Exhibition, Barcelona, 1929

B. School of Architecture and Design, 1952
Illinois Institute of Technology, Chicago, 1940

Ludwig Mies van der Rohe (1886-): born Aachen, Germany; worked with Behrens 1908-11;

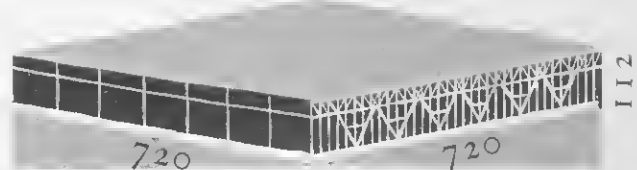
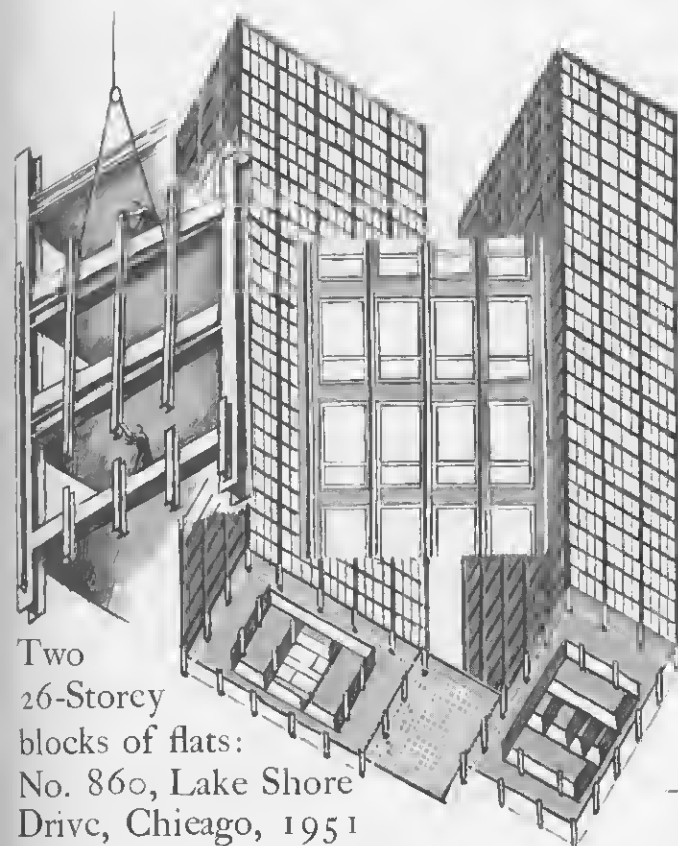
GERMANY & U. S. A.



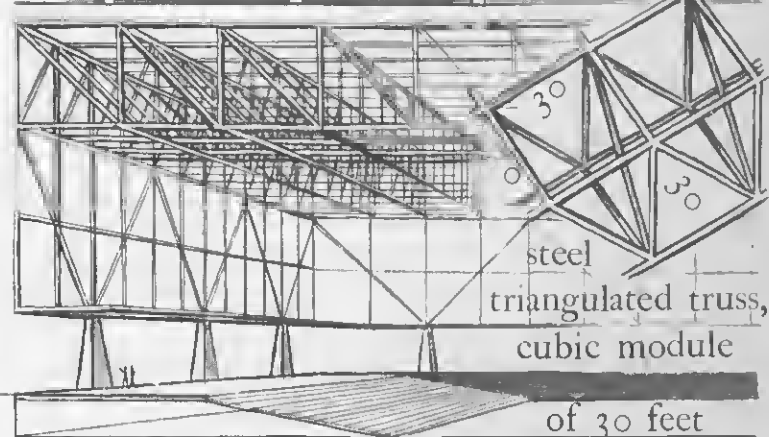
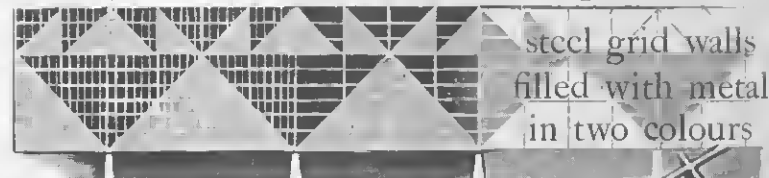
Bauhaus Buildings, Dessau, 1926.

Project: the 'Total Theatre', 1927

Weimar 1919-25, at Dessau 1925-8; worked in England 1934-37 (p.161), U.S.A. 1937



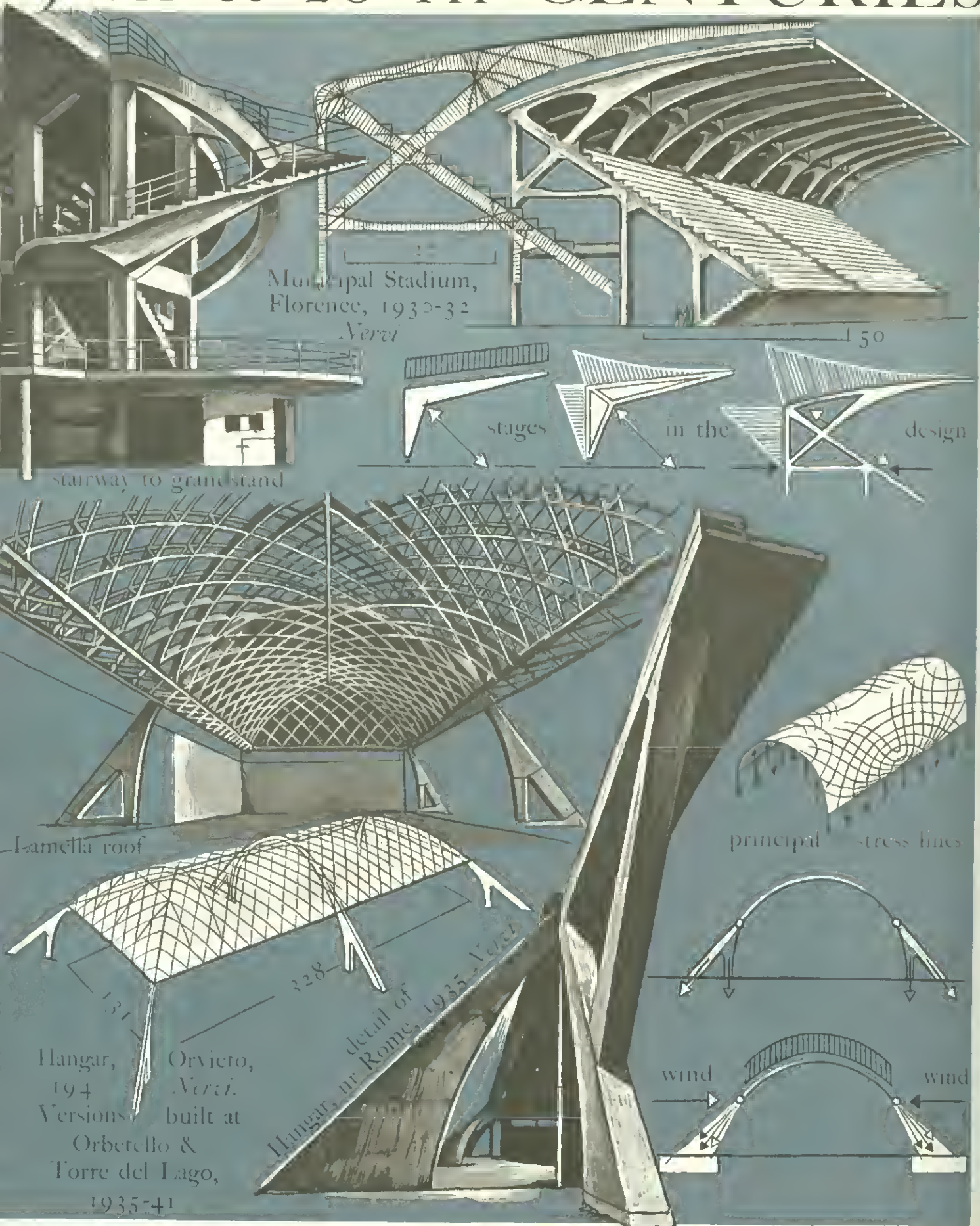
Project: Convention Hall, Chicago, 1953



Two 26-Storey blocks of flats: No. 860, Lake Shore Drive, Chicago, 1951

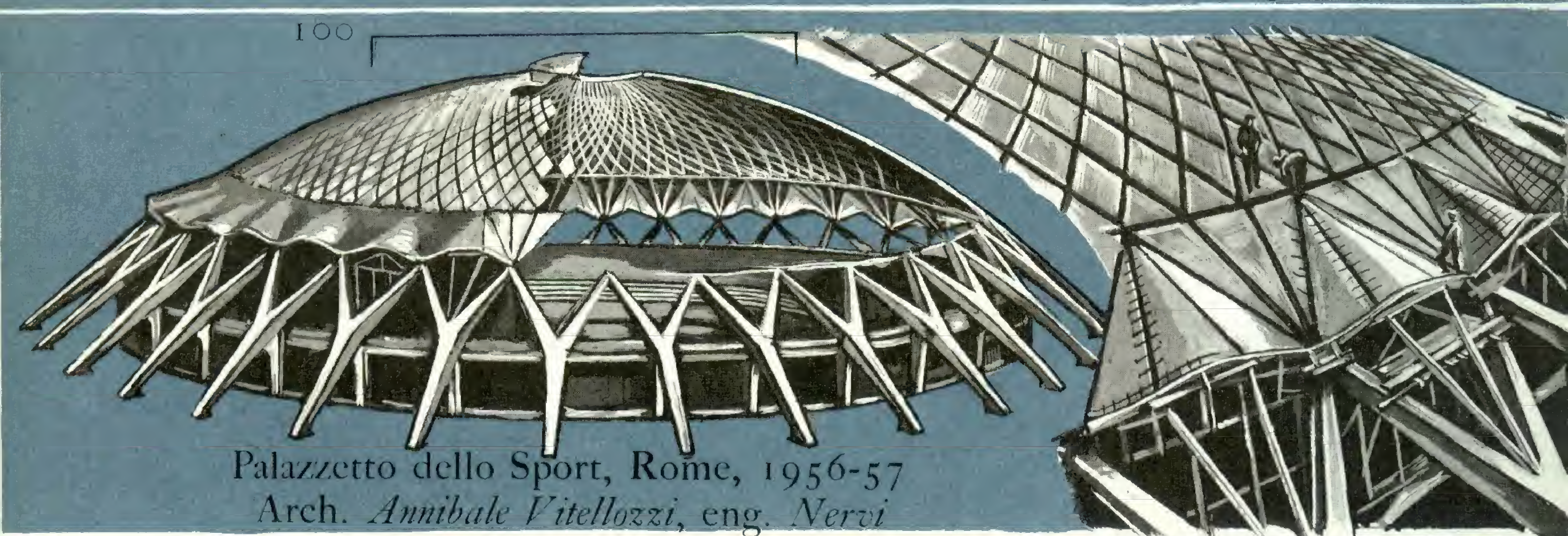
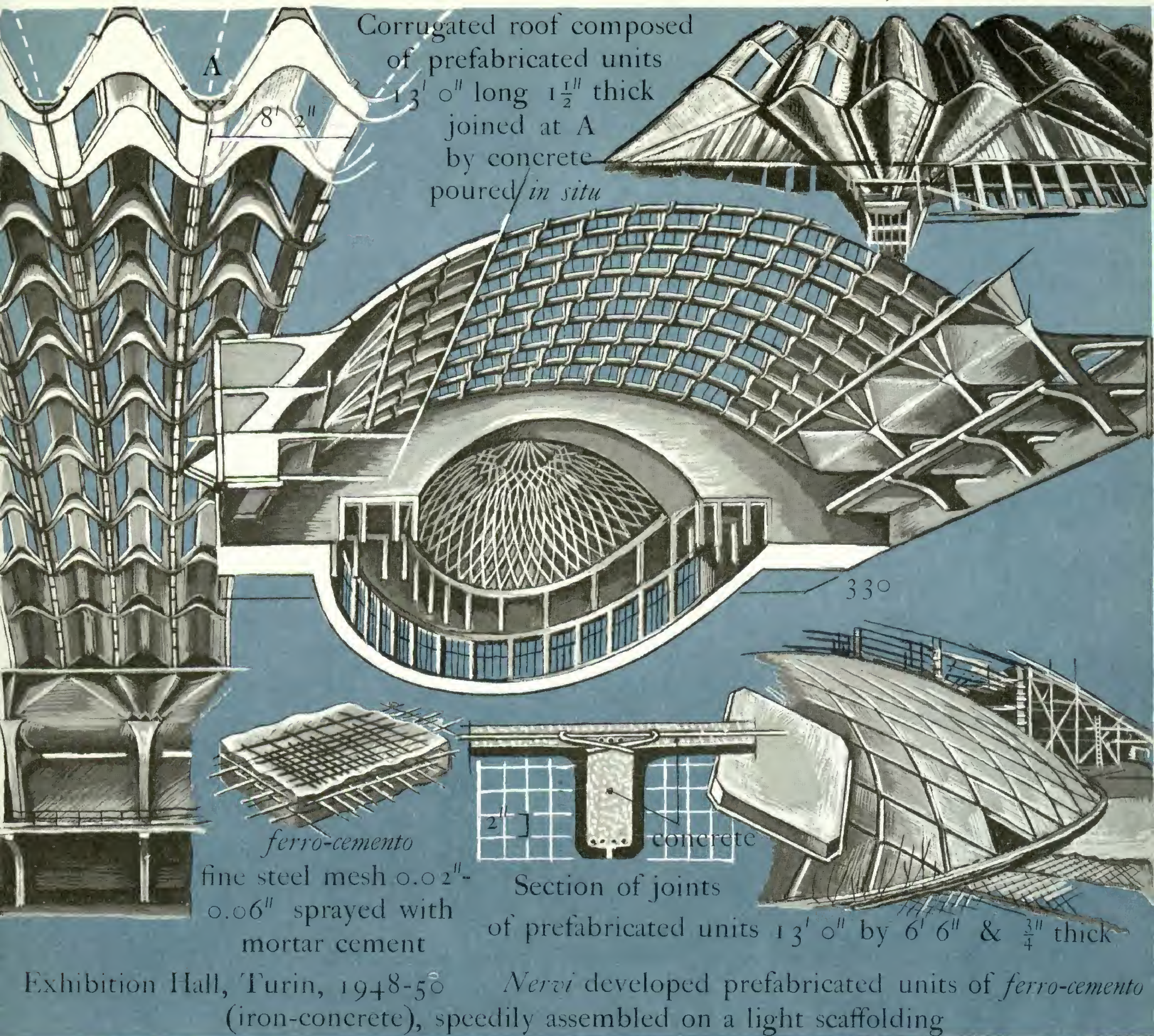
director of the Bauhaus, Dessau, 1930-33; to U.S.A., 1937. His dictum: 'less is more'

19 TH & 20 TH CENTURIES



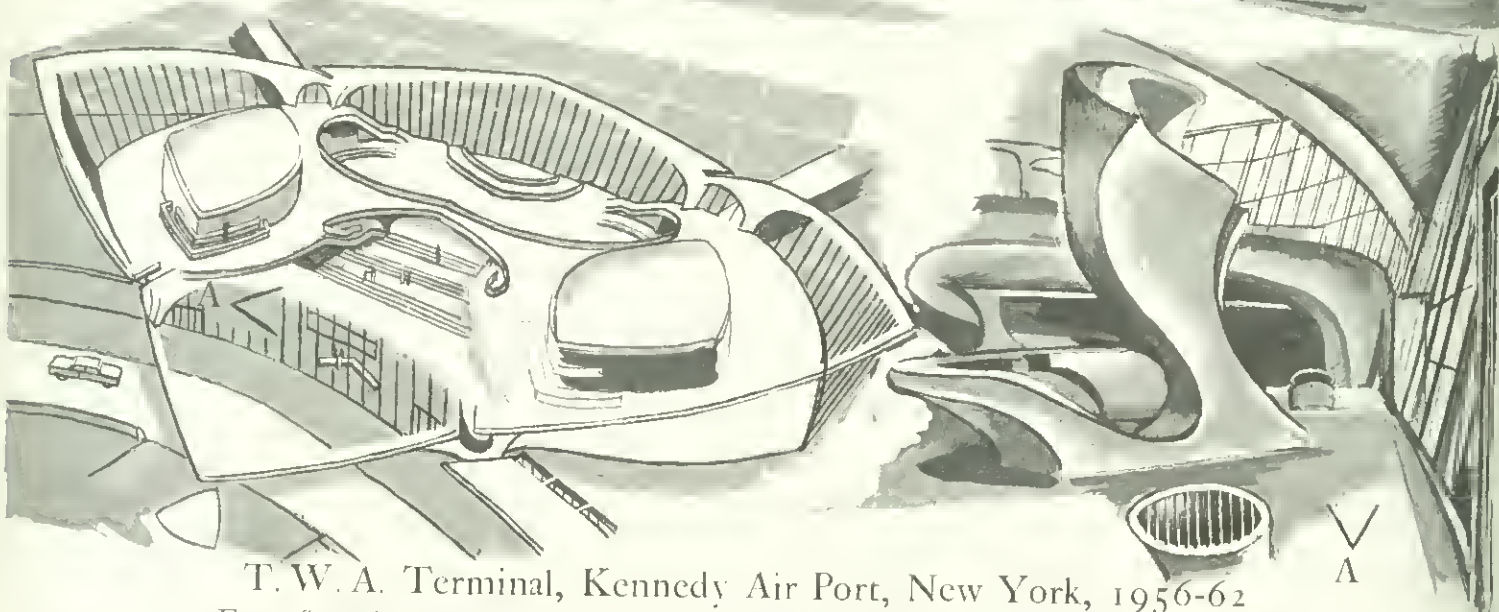
Perí Luigi Nervi (1891-), born Lombardy, engineer in reinforced concrete, follows 'both

ITALY, NERVI

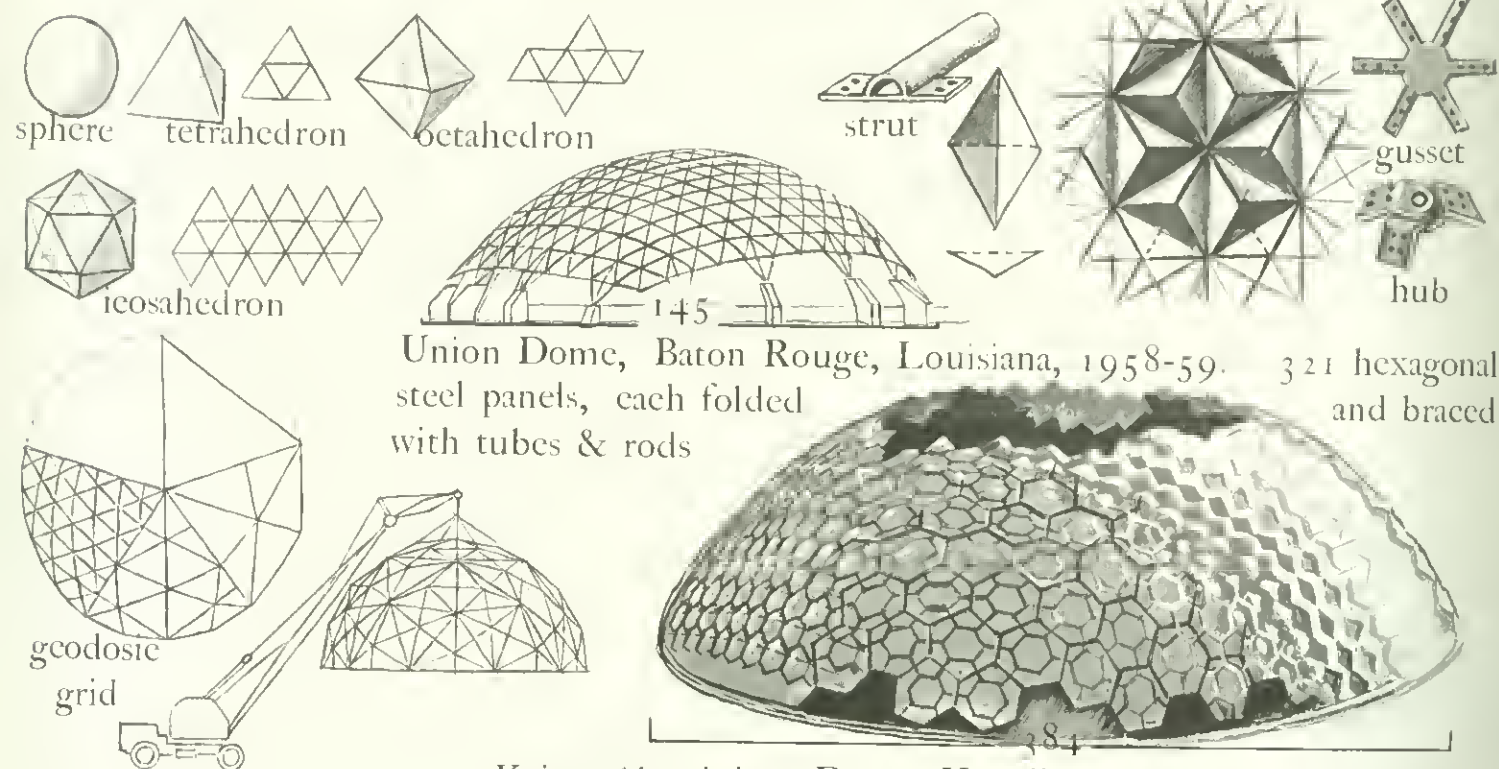


the intuitive & mathematical paths'. Author of *Construction, Science or Art?*, Rome, 1945

A black and white architectural rendering of a modern building. The building features a curved, ribbed facade and large glass windows. A small car is parked in front of the building. The rendering is a detailed sketch, showing the building's form and the surrounding environment.

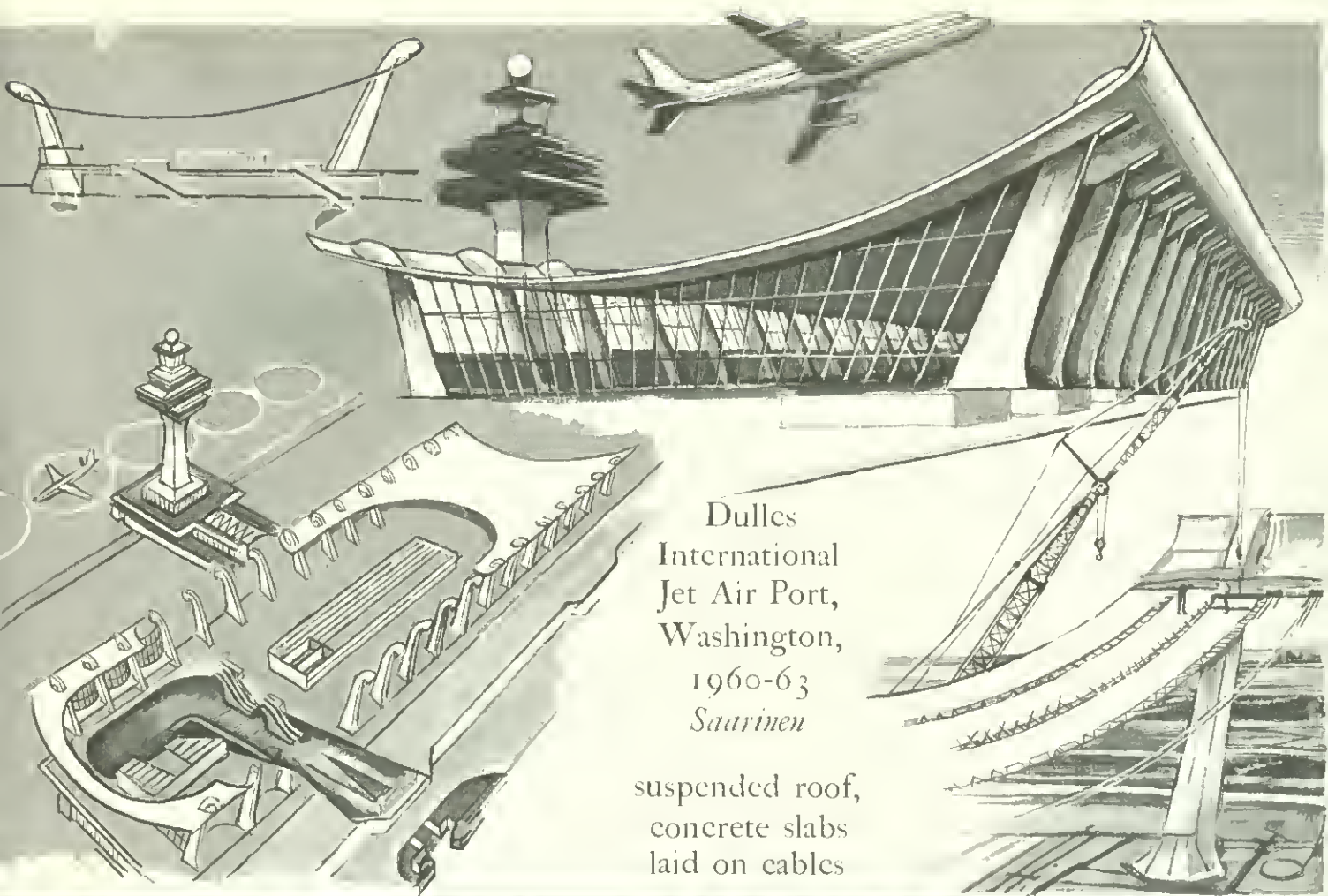


T. W. A. Terminal, Kennedy Air Port, New York, 1956-62
Eero Saarinen (1910-61), born Finland, went to U.S.A. in 1923



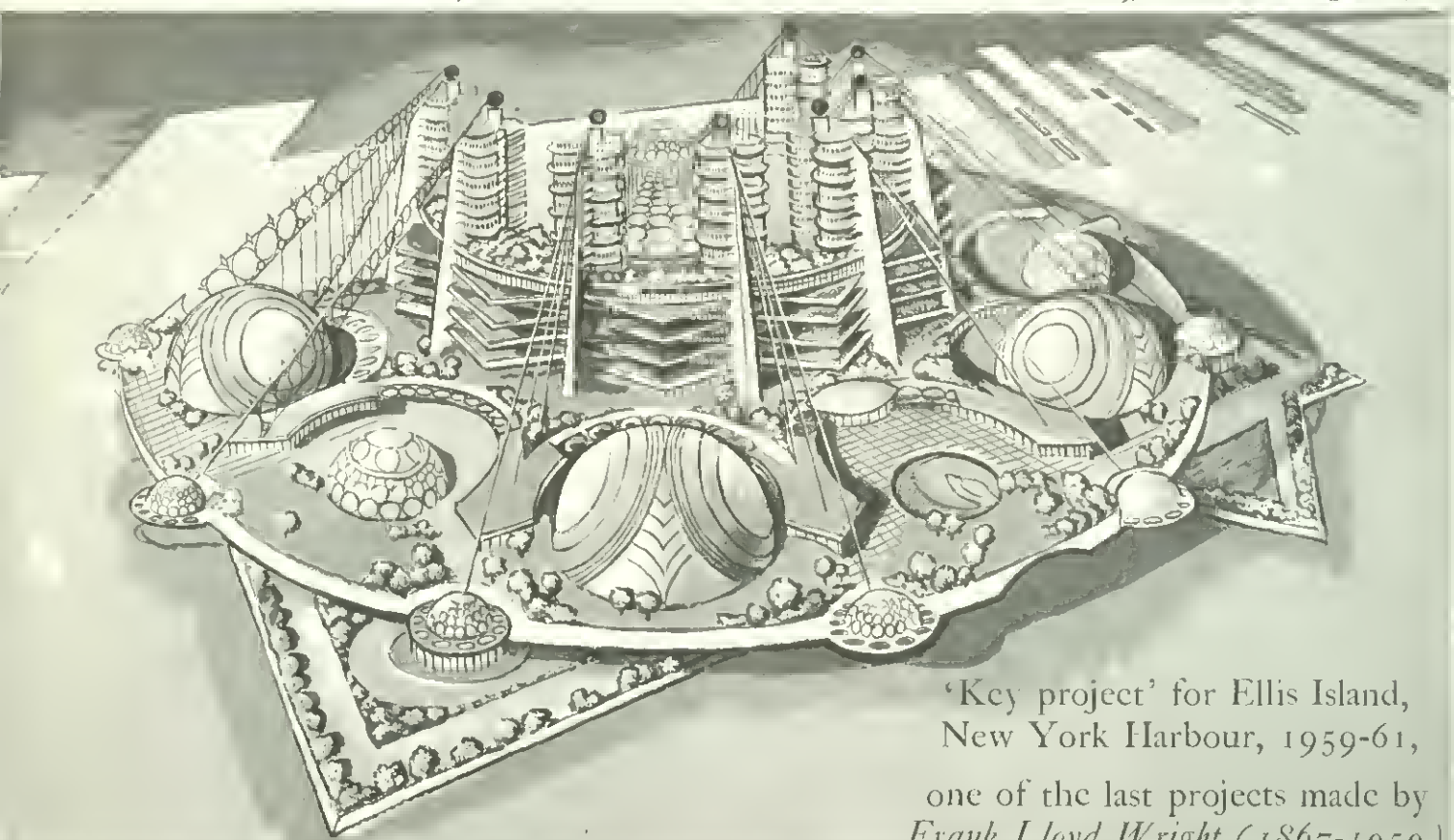
Union Dome, Baton Rouge, Louisiana, 1958-59. 321 hexagonal steel panels, each folded and braced with tubes & rods

Kaiser Aluminium Dome, Hawaii, 1957. Erected in 22 hours
Geodesic Domes from 1948 *Richard Buckminster Fuller* (1895-), 'comprehensive designer'



Dulles
International
Jet Air Port,
Washington,
1960-63
Saarinen

suspended roof,
concrete slabs
laid on cables



'Key project' for Ellis Island,
New York Harbour, 1959-61,
one of the last projects made by
Frank Lloyd Wright (1867-1959)